IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	09/803,173	Confirmation No.: 9334
Applicant	:	Chong Seng Cheng	
Filed	:	March 9, 2001	
TC/A.U.	:	2186	
Examiner	:	Choi, Woo H.	
Docket No.	:	1601457-0004	
Customer No.	:	007470	

AFFIDAVIT OF YONGMIN KIM
UNDER 37 CFR 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Yongmin Kim, Ph.D., of 4431 NE 189th Place, Seattle, WA 98155 do solemnly affirm and say as follows:

1. I, Yongmin Kim, am authorized by Trek 2000 International Ltd. ("Trek"), which is the assignee of record of the above-captioned patent application, to make this affidavit on its behalf. Unless stated otherwise, the matters discussed in this affidavit, which I believe to be true, are within my own knowledge and/or derived from the records of these proceedings to which I have ready access.

2. My credentials are set forth in my Curriculum Vitae, attached hereto as Exhibit **YK-1**. In summary, I have been teaching, working and researching in the fields of electrical engineering and computer engineering for more than 25 years. I have obtained bachelor's degree in electronics engineering from Seoul National University in Seoul, Korea in 1975, and master's and doctorate degrees in electrical engineering from the University of Wisconsin-Madison in 1979 and 1982, respectively.

3. I am currently a Professor in the Department of Electrical Engineering and Professor and Chair in the Department of Bioengineering at the University of Washington in Seattle. I am also an Adjunct Professor of Computer Science and Engineering. I have offered various lectures and courses to engineers and researchers around the world

including U.S., U.K., France, Italy, Korea, Singapore and Japan. My research interests include computer architectures, digital systems and subsystems and signal processing. I have supervised 29 Ph.D. dissertations and 101 Masters theses and am currently working with 15 Ph.D. students in addition to 2 professional research staff members. I have more than 40 patents issued and approximately 25 patents pending in the U.S. and abroad. I have transferred the invented technologies to industry with 23 licenses and helped with the commercialization of these technologies.

4. I have been a consultant to a number of governmental and commercial organizations, including U.S. government agencies, Intel, Siemens, Texas Instruments, Micron, Samsung, Hitachi, Fujitsu and Canon. I am a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). I have authored or co-authored many books and have more than 370 research publications. I am on the Editorial Board of several journals, including the Proceedings of the IEEE. Among many honors, I have received the 1988 Early Career Achievement Award of the IEEE/EMBS and the 2003 Ho-Am Prize in Engineering. I am the President of the IEEE/EMBS in 2005 and 2006. In 2004, the University of Washington Board of Regents appointed me as the Hunter and Dorothy Simpson Endowed Chair.

5. I am retained by Trek as a consultant to assist in the prosecution of the present application by providing a background discussion on the technology and explaining certain aspects of the invention disclosed and claimed in the present application based on my expertise and knowledge in the subject matter. Below I briefly describe portable mass storage devices and the state of the prior art. I also identify where aspects of the invention are taught in the specification and point out the differences between the prior art and the claimed invention in the present application.

Background

6. The computer technology at issue in the present application centers on "mass storage devices." Specifically, the present application discloses a portable mass storage device that is an alternative to, and eliminates the shortcomings of, traditional mass storage devices such as magnetic disks or CD-ROMs. *See, e.g.*, page 1, line 13 to page 2, line 11; page 9, lines 5 – 9.

7. A mass storage device is a storage device having a very large storage capacity. *IEEE Standard Dictionary of Electrical and Electronics Terms*, page 630, attached hereto as

Exhibit **YK-2**. Mass storage devices are indispensable elements of a computer system. They allow the computer and the computer user to store and transfer between computers large amounts of data (e.g., documents, graphics, audio, pictures, video, software programs, etc.) The data may be retrieved from the mass storage for later use.

8. Each computer typically has more than one type of mass storage. Most computers today come with a hard drive. A hard drive is a permanent type of mass storage device because it is permanently contained inside the computer.

9. In addition to permanent mass storage devices such as hard drives, virtually every computer allows a user to store large amounts of data on portable mass storage devices. There are many types of portable mass storage devices – floppy disks, CD-ROMs, ZIP disks, flash memory, etc. Data stored on portable mass storage devices can be carried away from one computer and transported to another computer. In addition, data is frequently archived on portable mass storage devices to back up a computer's hard drive.

10. Each of the different types of portable memory storage devices discussed above is designed to work in conjunction with a specially designed reader or a specially designed slot into which it is inserted. This has resulted in a series of compromises of, among other things, the portability, universality, or ease of use of the devices. The portable mass storage device disclosed in the present application does not require the use of a separate drive, reader/writer or cable and does not need to be installed inside the computer. Rather, the present application teaches a self-contained mass storage device having a USB plug that directly plugged into the USB socket of a host computer. Thus, the disclosed invention avoids the disadvantages that plagued much of the prior art. *See, e.g.*, page 1, line 13 to page 2, line 11; page 9, lines 5 – 9.

11. I am advised that claim 22, as amended, recites as follows:

> A unitary portable data storage device which can be directly plugged into a universal serial bus (USB) socket of a computer and which is operative to function as an alternative to a magnetic disk or CD, and which is capable of storing software for installation to the computer or of receiving and storing user's data present in the computer, the unitary portable data storage device comprising:
>
> ***a USB plug integrated into the unitary portable data storage device without an intervening cable capable of coupling the unitary portable data storage device directly to a USB socket on a computer;***

a single interface, said interface allowing the unitary portable data storage device to communicate via the USB protocol and being coupled to the USB plug;

a non-volatile solid-state memory, ***said memory being non-removable from the unitary portable data storage device and having sufficient capacity to enable the unitary portable data storage device to serve as an alternative to a magnetic disk or CD***; and

a memory controller, ***the memory controller being coupled between the interface and the memory to control the flow of data between the memory and the USB plug in a manner to enable the unitary portable data storage device to operate as an alternative to a magnetic disk or CD***.

(Emphasis provided).

12. In my view, as explained in more detail below, the present application discloses a portable mass storage device that, among other things: (1) includes a USB plug integrated into the device without an intervening cable capable of coupling the device directly to a USB socket on a computer; (2) is of unitary construction; and (3) includes a non-volatile solid-state memory that is non-removable from the device. As presented above, these limitations are expressly recited in claim 22 of the present application. It is also my opinion that the cited references do not teach at least some of these claim limitations. Again, I provide my explanations below.

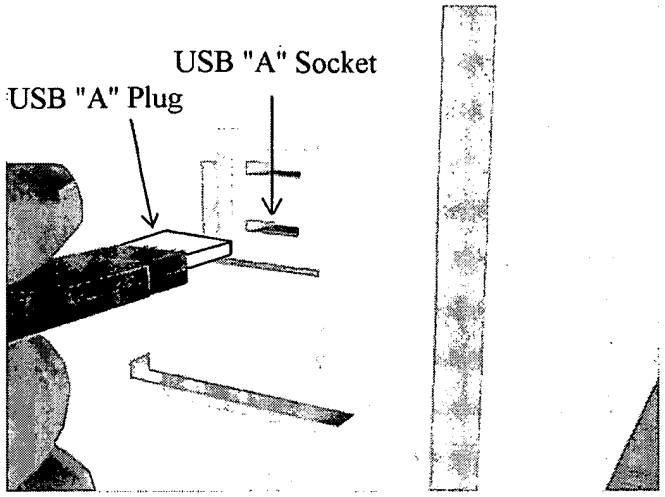
"Directly Without An Intervening Cable" Limitation

13. In my view, the specification as filed discloses the integrated plug of the USB device is directly plugged into a USB socket of a host computer. For example, on page 5, lines 18-19, the specification states that: "...the plug 1 of the device 10 is plugged into 20 to a USB socket on a computer."

14. In my opinion, in describing the structure of the portable mass storage device and how the device is connected to the host computer, the specification discloses the physical and electrical characteristics as well as compatibility of the device's integrated USB plug and the host computer's USB socket.

15. As mentioned above, the original specification clearly discloses that the claimed device 10 includes a USB plug 1, and that the host computer has a USB socket which the USB plug 1 of the device 10 plugs into.

16. It was well known in the art that host computers include a USB "A"-type socket as illustrated below. The USB Specification defines this. *See USB Specification Revision 1.1*, pages 73-74, attached hereto as Exhibit **YK-3**.



17. Consistent with the USB Specification and the teaching of the patent specification, I understand that USB plug 1 of the device would only be the type that is electrically and physically compatible with the host computer's USB "A"-type socket. This is called a USB "A"-type plug, as illustrated above. The physical and electrical characteristics of the USB "A" plug and the USB "A" socket are defined in the USB Specification.

18. When there is a USB "A" plug and a USB "A" socket, the intuitive and proper way to establish the connection between the two is by directly coupling the USB "A" plug to the USB "A" socket. The use of a cable between a USB "A" plug and a USB "A" socket is explicitly prohibited in the USB Specification. Thus, given the USB Specification and having read the specification of the present application, I clearly understand that the USB plug 1 of the disclosed device would directly connect to a USB socket of a host computer without any intervening cable.

19. The inventors' use of the D12 part in the Figure 1 in combination with the USB plug further supports my conclusion that the patent application discloses an integrated USB plug. D12 is a Philips part. D12 is used as the USB interface controller 2 in the device 10. Those skilled in the art at the time of the invention would understand that the D12 part was designed to be used on a printed circuit board in close proximity to the socket, as opposed to being connected to the socket via an intervening cable. (I should note that at the time of the invention, D12 would typically be proximately connected to a USB "B"-type socket rather than a USB "A"-type plug). I consider eliminating the need of the USB "B"-type socket and an intervening cable disclosed in the present application very innovative.

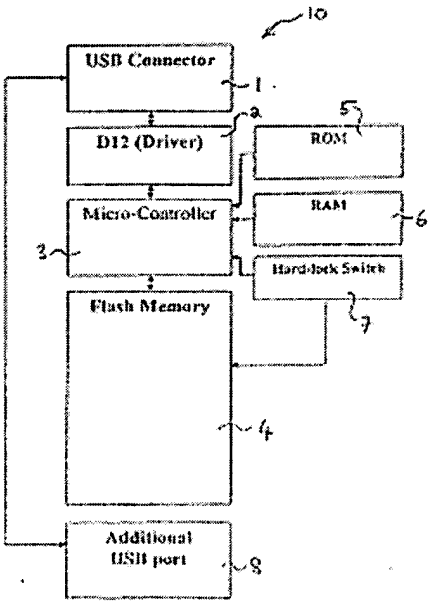
20. Therefore, it is my opinion that the patent specification as filed unambiguously discloses that the integrated USB plug of the storage device plugs directly into a USB socket on a computer.

"Unitary" and "Memory Being Non-Removable" Limitations

21. In my opinion, in describing and illustrating the structure and elements of the portable mass storage device (Figure 1) as well as the operation of the device, the original specification unambiguously teaches that the portable mass storage device described in the application is of unitary construction with an integrated USB plug and a non-volatile solid-state memory that is a fixed, non-removable element of the device.

22. In reading the present application, I note that the portable mass storage device 10 is consistently referred to as "a portable data storage device" or "the portable storage device" in the singular form. *See, e.g.,* page 1, lines 3 – 4, lines 24 – 25; page 2, lines 8 – 9; page 3, lines 12, 15 – 20 and 22; and page 4, lines 21.

23. Similarly, the elements of the portable mass storage device shown in Figure 1, reproduced below, are collectively referred to as the singular "device 10" throughout the specification.



24. Such description and illustration of the device highlights one of the innovative aspects of the invention — that the device is of unitary construction so it is easily portable and pluggable/removable from the host computer. This follows naturally from the

background discussion in the specification regarding the shortcomings of prior art mass storage devices and how the present invention eliminates those shortcomings.

25. In discussing the shortcomings of magnetic disks and CD-ROMs, the present application specifically points out that a separate drive mechanism is required in order to access the data on a magnetic disk or CD-ROM. The application also points out that as a surface-based storage device, a magnetic disk or CD-ROM is limited by its surface area. In other words, the storage capacity of a magnetic disk or CD-ROM is constrained by the size of the disk or CD-ROM. These characteristics of magnetic disks and CD-ROMs make them bulky, delicate and generally less than ideal in terms of portability. *See* page 1, lines 13 – 22.

26. In light of this background discussion, it is clear the present invention teaches a portable mass storage device of unitary construction with no removable part, including a fixed, non-removable non-volatile solid-state memory – as opposed to having a combination of a removable memory device and a drive mechanism as in the case of magnetic disks or CD-ROMs, where the disk or CD is routinely taken out of its drive so that it can be carried around to be used at a different drive on a different host computer.

27. Referring to Figure 1, reproduced above, the specification states: "Figure 1 shows a data storage device 10 which includes a USB plug 1 which is coupled to a USB interface device 2. The USB interface device 2 is coupled to a micro-controller 3 which is coupled to a flash memory 4." Page 3, lines 22 – 24. Having read the entirety of the specification, including Figure 1 and its corresponding description, I do not consider Figure 1 as disclosing a removable memory or a USB plug connected to the device by a cable. Rather, given that portable mass storage device 10 includes a USB plug 1, a USB interface device 2, a micro-controller 3 and a flash memory 4 coupled one after the other as described, it is clear to me that flash memory 4 is a flash memory chip fixedly installed (e.g., soldered to the circuit board) within the device 10 together with micro-controller 3 and USB interface device 2.

28. It is generally understood in the art that unlike certain types of memory chips that are intended to be removable from the device in which the chip is installed (for example, EPROMs can be removed so that its contents can be erased and re-programmed), flash memory chips are fixedly installed within a device and are non-removable under

normal use of the device. The present application does not teach otherwise. Thus, I understand the specification to teach a unitary portable mass storage device with a non-removable flash memory.

29. In addition to the above, I respectfully direct the Examiner's attention to the following disclosure in the specification: "[i]f the installation of the software is complete, ... *the device 10 may then be removed [] from the USB socket* on the computer" (emphasis provided). Page 7, lines 19 – 22. I note that these passages describe the device, rather than the plug, as being removed from the socket. If the specification had intended to teach a device that requires a cable to connect to the USB socket, it would not have spoken of plugging or removing the device itself into or from the socket. Instead, it would have said, "the plug 1 of the device 10 may then be removed." This further confirms that the unitary portable storage device disclosed in the original specification has an integrated USB plug, allowing the device to be plugged directly into the USB socket on a computer without an intervening cable.

30. As described above, the inventors' use of the Philips' D12 part further supports my opinion that one skilled in the art, reading the patent application, would understand that the invention discloses a device of unitary construction.

31. In sum, when read and understood in the context of the problems in prior art mass storage devices, how the present invention solves those problems and how the disclosed device operates, I find the specification as a whole clearly conveys to me that the portable mass storage device is of unitary construction, having a non-removable memory chip installed within it and a USB plug integrated into it without an intervening cable.

U.S. Patent No. 6,038,320 – The "*Miller*" Reference

32. I have reviewed the *Miller* reference. The device taught in *Miller* is neither designed to serve as a mass storage device, nor does it have the capability or capacity to do so. Rather, the *Miller* device is designed to limit access to a computer and store only a unique key code and an encrypted password, both of which are of limited size (e.g., *Miller* suggests that the password can be six bytes, *see* column 3, lines 42 – 43).

33. My review of the *Miller* reference indicates that the device disclosed in *Miller* does not have the requisite capability or capacity to be a mass storage device. *Miller* does not teach using a memory that has a large enough capacity for use in a mass storage

device. Instead, it teaches that its memory is used to store a key code or password of limited size. Similarly, *Miller* does not teach using a memory controller that can handle the data flow in a mass storage device. *Miller* also does not otherwise suggest that the device can be used to store a substantial amount of data. Therefore, I conclude that *Miller* fails to disclose at least the "memory having sufficient capacity" and "memory controller ... to control the flow of substantial amounts of data" claim limitations in claim 22 of the present application.

U.S. Patent No. 6,457,099 – The "*Gilbert*" Reference

34. I have reviewed the *Gilbert* reference and I am of the view that it does not disclose a unitary portable data storage device having a USB plug integrated into it without an intervening cable capable of coupling the unitary portable data storage device directly to a USB socket on a computer.

35. *Gilbert* teaches a programmable dedicated application card (PDAC) that executes dedicated software application(s) stored in the PDAC and sends the results to a user via a host computer to which the PDAC is connected. *See, e.g.,* column 1, lines 45 – 62. *Gilbert* teaches that using a dedicated RISC processor in the PDAC to run software improves execution speed. *Gilbert* also teaches that by running the software on the PDAC instead of on the host computer, resources of the host computer are freed up for other tasks, thereby improving the host's performance. *See, e.g.,* column 1, line 63 to column 2, line 7.

36. *Gilbert* further states that a PDAC is its own stand-alone computer system, and the use of a PDAC functions as a hardware accelerator and enhances the capabilities of the host computer system. *See, e.g.,* column 2, lines 33 – 36; column 3, lines 21 – 26.

37. However, *Gilbert* does not teach a USB plug integrated into a unitary device or a storage device as recited in claim 22 of the present application. I respectfully disagree that the cited portion of *Gilbert* (column 7, lines 11 – 30) discloses this claim limitation.

U.S. Patent No. 6,786,412 – The "*Kondo*" Reference

38. I have also reviewed *Kondo* and I am of the view that it does not disclose a unitary portable data storage device having a USB plug integrated into it without an intervening cable capable of coupling the unitary portable data storage device directly to a USB socket on a computer.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the present application or any patent issued thereon.

Respectfully submitted,

Dated: March 17, 2005

Yongmin Kim

January 26, 2005

CURRICULUM VITAE

PERSONAL

Name:	**Yongmin Kim**
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Phone:	(206) 685-2271 and (206) 685-2002
Fax Number:	(206) 221-6837 and (206) 685-3300
Birthdate:	May 19, 1953
Marital Status:	Married, three children

EDUCATION

Ph.D.	Department of Electrical and Computer Engineering, University of Wisconsin-Madison, August 1982
M.S.	Department of Electrical and Computer Engineering, University of Wisconsin-Madison, May 1979
B.S.	Department of Electronics Engineering, Seoul National University, February 1975

PROFESSIONAL EXPERIENCE

3/1/99 - :	Professor and Chair Department of Bioengineering Professor of Electrical Engineering Adjunct Professor of Computer Science and Engineering, and Radiology University of Washington
4/1/04 - :	The W. Hunter and Dorothy L. Simpson Endowed Chair in Bioengineering University of Washington
9/16/90 - 2/28/99:	Professor of Electrical Engineering Adjunct Professor of Bioengineering, Computer Science and Engineering, and Radiology University of Washington
9/16/86 – 9/15/90:	Associate Professor of Electrical Engineering

	Adjunct Associate Professor of Bioengineering Adjunct Associate Professor of Computer Science (1988-) University of Washington
9/16/82 – 9/15/86:	Assistant Professor of Electrical Engineering Adjunct Assistant Professor of Bioengineering (1984-) University of Washington
1976 - 1982:	Research, Project and Teaching Assistant University of Wisconsin-Madison
1993-1994:	Sabbatical Leave Siemens Medical Systems, Ultrasound Group, Issaquah, WA

HONORS

Merit Scholarship (Korea), 1971-1974
University of Wisconsin Tuition Scholarship, September 1978
Finalist in ACEMB Student Paper Competition, Houston, September 1981
Finalist in SCAMC Student Paper Competition, Washington, November 1981
Physio Control Career Development Award, 1982-1985
Who's Who in Frontiers of Science and Technology, 1985
Whitaker Foundation Biomedical Engineering Grant Award, 1986
Nominated for UW TYEE Instructor of the Year, 1987
Who's Who in the World, 1987-88, 1990-91, 1993-94, 1994-95, 1995-96, 1996-97, ...
IEEE/EMBS Early Career Achievement Award, 1988
Outstanding Young Korean selected by the *Chosun-Ilbo*, 1990
One of the 39 "39ers" selected by the *Seattle Weekly*, 1990
IEEE/EMBS Distinguished Lecturer, 1991-
Who's Who in the West, 1993, 1994, 1995, 1997, 1998, ...
Who's Who in Science and Engineering, 1992, 1994, 1996, 1997, 1998, ...
Who's Who in Finance and Industry, 1996
Sony's Sabbatical Chair (did not take), 1993
Fellow of the American Institute of Medical and Biological Engineering, 1995
Fellow of the Institute of Electrical and Electronics Engineers (IEEE), 1996
Ho-Am Prize in Engineering, 2003
The W. Hunter and Dorothy L. Simpson Endowed Chair, 2004
Member of Tau Beta Pi and Eta Kappa Nu

TEACHING

Have received consistently very good to excellent ratings from students.

Undergraduate Courses Taught

Autumn 1982	EE371 Computer Operation and Organization (52 students)
Winter 1983	EE371 Computer Operation and Organization (50)
Spring 1983	EE479 Microcomputer System Design (21)
Autumn 1983	EE372 Introduction to Microprocessors (50)
Spring 1984	EE478 Design of Computer Subsystems (24)
Autumn 1984	EE478 Design of Computer Subsystems (32)
Winter 1985	EE478 Design of Computer Subsystems (31)
Autumn 1985	EE478 Design of Computer Subsystems (28)

Winter 1986	ENGR190 Introduction to Logical System Design (82)
Spring 1986	EE478 Design of Computer Subsystems (28)
Autumn 1986	EE478 Design of Computer Subsystems (26)
Winter 1987	EE478 Design of Computer Subsystems (19)
Autumn 1987	EE478 Design of Computer Subsystems (17)
Winter 1988	EE478 Design of Computer Subsystems (20)
Autumn 1988	EE478 Design of Computer Subsystems (20)
Winter 1989	EE370 Intr. to Digital Systems & Computers (26)
Winter 1989	EE478 Design of Computer Subsystems (22)
Spring 1989	EE370 Intr. to Digital Systems & Computers (63)
Autumn 1989	EE370 Intr. to Digital Systems & Computers (70)
Autumn 1989	EE478 Design of Computer Subsystems (16)
Autumn 1990	EE370 Intr. to Digital Systems & Computers (103)
Autumn 1990	EE478 Design of Computer Subsystems (21)
Winter 1991	EE370 Intr. to Digital Systems & Computers (41)
Autumn 1991	EE478 Design of Computer Subsystems (19)
Spring 1993	EE371 Digital Circuits and Systems (49)
Autumn 1994	EE371 Digital Circuits and Systems (47)
Spring 1995	EE478 Design of Computer Subsystems (25)
Autumn 1995	EE371 Digital Circuits and Systems (38)
Spring 1997	EE371 Digital Circuits and Systems (51)
Spring 1998	EE400B Systems Engineering and Medical Imaging Informatics (11)
Spring 2000	EE400K/BIOEN599L Systems Engineering and Healthcare Information Technologies (E-Medicine) (7)
Winter 2001	EE400B/BIOEN599D Systems Engineering and Electronic Medicine (10)
Spring 2002	BIOEN480A Bioengineering Research/Senior Capstone Design (5)

Graduate Courses Taught

Winter 1983	EE590 Parallel Computer Systems (30)
Autumn 1983	EE590 Advanced Microprocessors and Their Applications (35)
Winter 1984	EE590 Parallel Computer Systems (22)
Summer 1984	EE590 Image Processing Computer Systems (22)
Autumn 1984	EE590 Advanced Microprocessors and Their Applications (24)
Autumn 1984	EE599 Seminars on Digital Image Processing & Applications (30)
Winter 1985	EE599 Weekly Seminars on Image Processing (20)
Summer 1985	EE599 Image Processing Computer Systems (10)
Autumn 1985	EE590 Advanced Microprocessors and Their Applications (14)
Autumn 1985	EE599 Weekly Seminars on Image Processing (15)
Winter 1986	EE599 Design & Development of an Optimum Pipelined Image Processor (12)
Summer 1986	EE590 Image Processing Computer Systems (19)
Autumn 1986	EE590 Weekly Seminars on Image Processing (42)
Winter 1987	EE599 Weekly Seminars on Image Processing (33)
Spring 1987	EE590 16 and 32-bit Microcomputer System Design (5)
Spring 1987	EE590 Computer Image Generation (42)
Summer 1987	EE590 Image Processing Computer Systems (25)
Autumn 1987	EE500 Weekly Seminars on Image Processing (49)
Autumn 1987	EE599 DIN/PACS Seminars (9)
Winter 1988	EE500 Weekly Seminars on Image Processing (36)
Winter 1988	EE599 DIN/PACS Seminars (10)
Spring 1988	EE568 Image Processing Computer Systems (21)
Spring 1988	EE599 DIN/PACS Seminars (9)
Summer 1988	EE590 Computer Image Generation (32)

Autumn 1988	EE500 Weekly Seminars on Image Processing (38)
Winter 1989	EE500 Weekly Seminars on Image Processing (42)
Summer 1989	EE590 Computer Image Generation (40)
Autumn 1989	EE500 Weekly Seminars on Image Computing (50)
Winter 1990	EE500 Weekly Seminars on Image Computing (48)
Spring 1990	EE568 Image Processing Computer Systems (22)
Summer 1990	EE590 Computer Image Generation (25)
Autumn 1990	EE500 Weekly Seminars on Image Computing (72)
Winter 1991	EE568 Image Processing Computer Systems (23)
Winter 1991	EE500 Weekly Seminars on Image Computing (56)
Autumn 1991	EE500 Weekly Seminars on Image Computing (67)
Winter 1992	EE568 Image Processing Computer Systems (23)
Winter 1992	EE500 Weekly Seminars on Image Computing (46)
Spring 1992	EE590 Multimedia Chips and Systems (17)
Spring 1992	EE500 Weekly Seminars on Image Computing (41)
Autumn 1992	EE500 Weekly Seminars on Image Computing (51)
Winter 1993	EE568 Image Processing Computer Systems (17)
Winter 1993	EE500 Weekly Seminars on Image Computing (28)
Spring 1993	EE500 Weekly Seminars on Image Computing (36)
Autumn 1993	EE500 Weekly Seminars on Image Computing (40)
Winter 1994	EE500 Weekly Seminars on Image Computing (27)
Spring 1994	EE500 Weekly Seminars on Image Computing (20)
Autumn 1994	EE500 Weekly Seminars on Image Computing (57)
Winter 1995	EE568 Image Processing Computer Systems (18)
Winter 1995	EE500 Weekly Seminars on Image Computing (32)
Spring 1995	EE500 Weekly Seminars on Image Computing (39)
Spring 1995	EE599 Multimedia Video Processor (9)
Autumn 1995	EE500 Weekly Seminars on Image Computing (35)
Winter 1996	EE568 Image Processing Computer Systems (19)
Winter 1996	EE500 Weekly Seminars on Image Computing (34)
Spring 1996	EE590 Multimedia Processor Architecture & Their Programming (5)
Spring 1996	EE500 Weekly Seminars on Image Computing (14)
Autumn 1996	EE590 Multimedia Processor Architecture & Their Programming (8)
Autumn 1996	EE500 Weekly Seminars on Image Computing (30)
Winter 1997	EE568 Image Processing Computer Systems (13)
Winter 1997	EE500 Weekly Seminars on Image Computing (27)
Spring 1997	EE500 Weekly Seminars on Image Computing (27)
Autumn 1997	EE590 Multimedia Processor Architecture & Their Programming (8)
Autumn 1997	EE500 Weekly Seminars on Image Computing (53)
Winter 1998	EE500 Weekly Seminars on Image Computing (30)
Winter 1998	EE568 Image Processing Computer Systems (15)
Winter 1998	EE599 MPEG-4 Algorithms and Applications (7)
Spring 1998	EE500 Weekly Seminars on Image Computing (23)
Autumn 1998	EE590 Multimedia Processor Architecture & Their Programming (12)
Autumn 1998	EE500 Weekly Seminars on Image Computing (51)
Winter 1999	EE568 Image Processing Computer Systems (18)
Winter 1999	EE500 Weekly Seminars on Image Computing (32)
Spring 1999	EE500 Weekly Seminars on Image Computing (39)
Autumn 1999	EE500/BIOEN599K Weekly Seminars on Image Computing (31)
Autumn 1999	EE590/BIOEN599X Multimedia Processor Architecture & Their Programming (12)
Winter 2000	EE568/BIOEN568 Image Processing Computer Systems (13)
Winter 2000	BIOEN599J Weekly Seminars on Bioengineering (28)
Spring 2000	BIOEN599J Weekly Seminars on Bioengineering (25)
Autumn 2000	EE500B/BIOEN599K Weekly Seminar on Image Computing and

	Medical Imaging (36)
Autumn 2000	EE590N/BIOEN599X Mediaprocessors: Their Architectures and Programming (11)
Winter 2001	BIOEN599J Weekly Seminar on Bioengineering (18)
Spring 2001	BIOEN/EE568 Image Processing Computer Systems (8)
Spring 2001	BIOEN599J Weekly Seminar on Bioengineering (25)
Autumn 2001	BIOEN599K/EE500B Weekly Seminar on Image Computing and Medical Imaging (37)
Autumn 2001	BIOEN599X/EE590 Advanced Mediaprocessors and Their Architectures (9)
Winter 2002	BIOEN599J Weekly Seminar on Bioengineering (30)
Spring 2002	BIOEN/EE568 Image Processing Computer Systems (16)
Spring 2002	BIOEN599J Weekly Seminar on Bioengineering (19)
Autumn 2002	BIOEN599K/EE500B Weekly Seminar on Image Computing and Medical Imaging (54)
Winter 2003	BIOEN599J Weekly Seminar on Bioengineering (66)
Spring 2003	BIOEN599J Weekly Seminar on Bioengineering (44)
Spring 2003	BIOEN599H Technology Innovation and Commercialization (24)
Spring 2003	BIOEN/EE568 Image Processing Computer Systems (7)
Autumn 2003	BIOEN599E Introduction to Technology Commercialization (28)
Autumn 2003	BIOEN599K/EE500B Weekly Seminar on Image Computing and Medical Imaging (38)
Winter 2004	BIOEN599Y Studies in Technology Commercialization (13)
Winter 2004	BIOEN599J Weekly Seminar on Bioengineering (40)
Spring 2004	BIOEN/EE568 Image Processing Computer Systems (8)
Spring 2004	BIOEN599J Weekly Seminar on Bioengineering (30)
Autumn 2004	BIOEN599E Introduction to Technology Commercialization (47)
Winter 2005	BIOEN599Y Studies in Technology Commercialization (14)

New Courses Developed

Winter 1983	EE564 Parallel Computer Systems regular spring quarter graduate course
Autumn 1983	EE590 Advanced Microprocessors and Their Applications graduate course
Spring 1984	EE478 Design of Computer Subsystems regular senior elective course
Summer 1984	EE568 Image Processing Computer Systems regular spring quarter graduate course joint with Bioengineering
Autumn 1984	EE599 Seminars on Digital Image Processing & Applications regular quarterly seminar course EE500
Winter 1986	EE599 Design & Development of an Optimum Pipelined Image Processor experimental graduate course and constructed an image processor
Spring 1987	EE590 Computer Image Generation graduate course on computer graphics with Rich Johnston at BBN Delta Graphics

Autumn 1987	EE599 Seminars on Digital Imaging Network & Picture Archiving & Communications System regular Bioengineering course by Alan H. Rowberg in Spring, 1989
Spring 1992	EE590 Multimedia Chips and Systems graduate course on multimedia algorithms and systems based on research results and experience from UWGSP projects
Spring 1995	EE599 Multimedia Video Processor graduate course on the TMS320C80 Multimedia Video Processor based on our research on TMS320C80 chip architecture and its programming
Spring 1996	EE590 Multimedia Processor Architectures and Their Programming graduate course on the TMS320C80 Multimedia Video Processor and the next-generation programmable multimedia processors
Winter 1998	EE599 MPEG-4 Algorithms and Applications graduate course on studying the MPEG-4 Standard in detail and discussing its potential applications in medicine, distance learning, and others.
Spring 1998	EE400B Systems Engineering and Medical Imaging Informatics undergraduate course on systems engineering, medical informatics, and medical imaging systems based on the $514K grant from Hewlett-Packard Company
Winter 2000	BIOEN599J Weekly Seminars on Bioengineering graduate course
Spring 2002	BIOEN480A Bioengineering Research/Senior Capstone Design undergraduate core course
Spring 2003	BIOEN599H Technical Innovation and Commercialization Senior/graduate-level course for students in science and engineering
Autumn 2003	BIOEN599E Introduction to Technology Commercialization Senior/graduate-level course
Winter 2004	BIOEN599Y Studies in Technology Commercialization Senior/graduate-level course

Curriculum Improvements

EE371, Improved the course contents significantly by emphasizing the microprogramming technique and operating system concepts. Also developed and implemented a cross compiler software package for microprogramming simulation. Autumn 1982.

EE372, Changed the course from assembly language programming to microprocessor software and hardware, Autumn 1983.

ENGR190, Restructured and significantly upgraded the course contents with a new textbook to change it into EE370, Winter 1986.

EE370, EE478, Added a laboratory to introduce students to the VALID CAE (Computer Aided Engineering) schematic capture and simulation software on the VAX Workstations, Winter 1989.

EE478, Introduced advanced hardware design issues, e.g., Verilog hardware description language, and noise sources in high-speed digital system design, and how to control them, 1990.

Led the committee in revising the undergraduate courses in Electronics and Computer Hardware, ENGR275, EE371 (a new core course under the approved curriculum), EE372, EE471, EE476, EE478, and EE479), 1991.

Selected the textbook, and developed the course outline and all the laboratories, and taught EE371, a new 5-credit core course on digital circuits and systems which was implemented in Winter/Spring 1993.

RESEARCH

Current Active Research Grants and Contracts

Principal Investigator, "Mapping of Ultrasound Algorithms onto a Mediaprocessor-based Architecture," Hitachi Medical Corporation, 2/01/00 -1/31/05, $1,863.320.

Principal Investigator, "Research and Development on the University of Washington Image Computing Library for MAP," Hitachi, Ltd., 3/1/98 - 2/28/05, $750,000.

Principal Investigator, "MAP University of Washington Image Computing Library Consortium," Various Companies, 5/19/99 – 12/31/04, $320,000.

Principal Investigator, "Prostate Boundary Detection in Ultrasound Images," National Institutes of Health, 9/01/00 - 8/31/05, $203,619.

Principal Investigator, "University of Washington Mediaprocessor User Consortium," Various Companies, 3/1/01 – 2/28/05, $148,000.

Principal Investigator, "Bioengineering in the 21st Century," Whitaker Foundation, 5/1/01 – 4/30/06, $10,000,000.

Principal Investigator, "C64 University of Washington Image Computing Library Consortium," Various Companies, 3/1/02 - 2/29/05, $96,000.

Principal Investigator, "Singapore-University of Washington Alliance in Bioengineering," National Science and Technology Board in Singapore, 7/1/02 – 5/31/07, $14,000,000.

Investigator, "Intraoperative Dose Optimization for Prostate Brachytherapy," U.S. Army, 5/1/2003 – 4/30/2006, $568,500.

Previous Research Grants and Contracts

Principal Investigator, "Three-dimensional Reconstruction, Computing and Image Processing for the Flow Optical Tomography System," VisionGate, 11/16/02 - 5/15/03, $3,022.

Principal Investigator, "Digital Radiography Computing with Mediaprocessors," Canon Inc.,

1/1/01 – 12/31/01, $300,000.

Principal Investigator, "Image and Video Computing with the Programmable Mediaprocessors," Canon Inc., 12/16/97 – 2/19/02, $1,500,000.

Principal Investigator, "MPEG-4 Decoder Development on the V4400 and Architectural Evaluation for Future Mediaprocessors," Micron Technology, Inc., 5/8/00 – 12/31/01, $200,927.

Consultant, "Alzheimer Disease Research Center," George M. Martin, Center Director, PI, Consultant to the General Autopsy and Neuropathology Service Core assisting in the implementation of a program of quantitative digital image analysis systems, National Institutes of Health, $116,933 per year, Funding period: 5/1/95 - 4/30/00.

Principal Investigator "Development of Core Image Computing Functions on the ManArray Architecture," Billions of Operations Per Second (BOPS), 11/1/99 - 4/30/00, $41,131.

Principal Investigator, "Development of a Multimedia Computing Engine Architecture, Library and Applications for the HMPV Processor," Hitachi, Ltd., 12/18/95 - 2/29/98, $750,000.

Consultant, "Integrated Medical Imaging Software Using Distributed Objects," Vikram Chalana (StatSci, Inc.), PI, National Institutes of Health, 1/1/98 - 12/31/99, $750,000.

Principal Investigator, "Development of Image Computing Technologies and their Applications in Ultrasound Imaging," Siemens Medical Systems, 8/16/92 - 8/15/00, $957,887.

Principal Investigator, "A New Curriculum on Systems Engineering, Medical Imaging Informatics and Imaging Systems," Hewlett-Packard Company, 6/16/97 - 6/15/99, $514,000 + $150,000 UW matching.

Principal Investigator, "UWGSP10: Generalized Backend Computing Board for Medical Ultrasound Processing," Washington Technology Center and Siemens Medical Systems, 8/16/97 - 8/15/99, $819,656.

Principal Investigator, "Contrast Enhancement of Video Signals for Industrial Process Monitoring, Washington Technology Center and Quadtek, Inc., 3/16/97 - 6/15/98, $26,500.

Principal Investigator, "Image Computing Library Consortium," 1/1/95 - 12/31/97, various companies, $500,000.

Principal Investigator, "An Optimized Telemedicine Workstation," Washington Technology Center and Precision Digital Images, 7/1/95 - 6/30/97, $200,000.

Co-Principal Investigator, "Communicating Situation Awareness in Virtual Environments," U.S. Air Force, 1/1/93 - 12/31/96, $2,500,000.

Principal Investigator, "Predicting Transvenous Defibrillation Efficacy," National Institutes of Health, 8/1/92 - 7/31/96, $708,444.

Principal Investigator, "MPEG-2 Decoding/Encoding," Hitachi, Ltd., 3/16/95 - 9/15/95, $30,000.

Principal Investigator, "UWGSP7: An Optical Imaging System to Aid Neurosurgeons," Washington Technology Center and Optimedx, 7/1/93 - 6/30/95, $280,000.

Investigator, "Advanced Human Interfaces for Telemedicine," Advanced Research Projects Agency, 7/15/94 - 7/15/95, $340,000.

Principal Investigator, "Computer-Aided Inspection of Potatoes and Other Agricultural Products by Digital Image Processing," Washington Technology Center, 03/01/95 - 06/30/95, $25,000.

Principal Investigator, "Design and Implementation of a ROC Study on MDIS Compression," U.S. Army; Loral; Siemens Gammasonics, Inc., 06/01/93 - 06/15/95, $78,331.

Principal Investigator, "UWGSP5: A Highly Integrated Low-Cost Multimedia System," GoldStar Co. Ltd., 7/1/91 - 8/31/94, $650,000.

Principal Investigator, "Implementation of Assistive Devices to Aid the Handicapped as Student Design Projects," National Science Foundation, 3/1/88 - 11/30/93, $76,168.

Principal Investigator, "Quality Control Assessment for the Medical Diagnostic Imaging Support (MDIS) System," U.S. Army, 12/15/92 - 11/14/93, $24,999.

Principal Investigator, "Parallel Image Computing Workstations for Multimedia," Washington Technology Centers, 7/1/91 - 6/30/93, $50,000.

Principal Investigator, "High-Quality Three-Dimensional Image Compression Techniques," Washington Technology Centers, 7/1/90 - 6/30/93, $58,750.

Principal Investigator, "Teleimaging Algorithm Development," Texas Instruments, 4/1/90 - 3/31/93, $125,000.

Co-Principal Investigator, "IBM-UW Joint Study in Advanced Medical Imaging Within the Center of Excellence on Imaging Systems Optimization," (Dr. Greg Zick, Co-Principal Investigator), IBM, 4/1/90 - 3/31/93, $3,000,000.

Principal Investigator of the Image Analysis Core to the Program Project, "Mechanisms of Acute Vascular Reaction to Injury," (Dr. S. M. Schwartz, Program Director), National Institutes of Health, 3/1/88 - 2/28/93, core's total amount $193,584.

Principal Investigator, "University of Washington Graphics Accelerator (UWGPX)," VLSI Technology, 7/1/91 - 12/31/92, $510,000.

Principal Investigator, "Development and Validation of Anatomy-Based Three- Dimensional Thorax Models with FEM," Medtronic, Inc., 5/1/91 - 12/31/92, $35,000.

Principal Investigator, "One GFLOPS Workstation for Real-Time Imaging and 3-D Graphics," Samsung Advanced Institute of Technology, 9/1/89 - 3/31/92, $635,515.

Principal Investigator, "Development of an Anatomy-Based High-Resolution Three-Dimensional Human Thorax Model," Physio Control Corporation, 1/16/90 - 12/31/91, $63,000.

Principal Investigator, "Design of a Special-Purpose Processor for Imaging, Graphics and Multimedia Support in the Intelligent Computer," Electronics and Telecommunications Research Institute, 4/1/91 - 9/30/91, $50,000.

Principal Investigator, "Development of an Interactive Floating-Point 2-D Image Filtering Library with a Graphical User Interface," Naval Research Laboratory, 7/16/89 - 6/30/91, $62,076.

Principal Investigator, "Distributed Scheduling Algorithms for Sharing Workstations and Supercomputers in a Networked Biomedical Image Computing Environment," The Keck Foundation, 8/16/89 - 6/15/91, $25,000.

Principal Investigator, "High-Speed Data Interchange Scheme for the Next Generation Multiprocessor System," Electronics and Telecommunications Research Institute, 10/1/89 - 3/31/91, $90,987.

Co-Principal Investigator, "CT Reconstruction," (Dr. Alan H. Rowberg, Principal Investigator), Institute for Radiological Image Sciences, 10/1/88 - 12/31/90, $50,200.

Principal Investigator, "High-Performance Imaging and Graphics Workstation," Daewoo Telecom Company, 9/1/89 - 10/31/90, $210,919.

Principal Investigator, "High-Performance Multiprocessor Bus Design," Electronics and Telecommunications Research Institute, 11/24/88 - 9/15/90, $99,000.

Investigator, "AUV Lens," (Dr. Ed Belcher, Principal Investigator), Naval Research Laboratory, 1/1/89 - 6/30/90, $180,000.

Consultant, "Alzheimer Disease Research Center," George M. Martin, Center Director, consultant to the General Autopsy and Neuropathology Service Core assisting in the implementation of a program of quantitative digital image analysis systems, National Institutes of Health, 10/1/85 - 6/30/90, $4,100,000.

Investigator (in charge of engineering studies), "Digital Imaging Network & Picture Archiving and Communications System (DIN/PACS)," (Dr. John W. Loop, Principal Investigator), U.S. Army, 9/22/86 - 12/31/89, $2,750,000.

Principal Investigator, "User Interface and Acceptance Studies with DIN/PACS Workstation," Texas Instruments, 1/1/89 - 12/31/89, $15,000 plus $75,000 equipment.

Principal Investigator, "Pattern Recognition and Image Processing for Automatic Feature Detection from Maps and Aerial Photographs," BBN Delta Graphics, 1/1/88 - 6/30/89, $25,000.

Co-Principal Investigator, "Machine Vision for Automated Manufacturing," National Science Foundation Equipment Grant, 6/10/87 - 2/28/89, $100,000.

Principal Investigator, "Development of Image Processing Applications Hardware and Software for the TI's SN74ACT8837," Texas Instruments, 11/1/87 - 11/30/88, $67,500.

Principal Investigator, "Development of a General-Purpose Three-Dimensional Human Body Computer Model," Physio Control Corporation and Cardiac Pacemakers Inc., 3/1/84 - 6/15/88, $73,396.

Investigator, "Mechanisms of Acute Vascular Reaction to Injury," Program Project (Dr. Schwartz, Program Director), 10% effort in a project developing a powerful microcomputer-based image processing computer system, National Institutes of Health, 3/1/85 - 2/29/88, $3,848,086.

Co-Principal Investigator, "3-D Analysis of MRI of the Spine," Siemens Medical Systems, 9/1/87 - 2/29/88, $8,200.

Principal Investigator, "Intelligent Workstation Multifunction Processor," Boeing High Tech Center, 4/1/87 - 12/31/87, $49,999.

Principal Investigator, "Integration of the Optical Disk to the Interactive Graphics System," Northwest Research Associates, 4/1/87 - 7/31/87, $7,703.

Principal Investigator, "Biomedical Image Processing Systems for Quantitative Microscopy," The Whitaker Foundation, 3/1/86 - 6/15/87, $47,522.

Principal Investigator, "Display Generation Requirements Study," Boeing Military Airplane Company, 10/10/86 - 3/31/87, $23,594.

Principal Investigator, "Electrical Impedance Technique in Medical Body Imaging," National Institutes of Health, 3/1/84 - 2/28/87, $204,747.

Principal Investigator, "Development of graphics and image processing application software and supporting hardware for the TMS34010 Graphics System Processor (GSP)," Texas Instruments Inc., 2/1/86 - 12/31/86, $50,000.

Principal Investigator, "Development of virtual image processing software package in Intel System 310", and "Finite element model implementation in Intel System 310," Intel Corporation, 12/15/84 - 9/30/86, $70,000.

Principal Investigator, "An optimized Fourier transform processor," Boeing Aerospace Company, 12/15/85 - 7/31/86, $24,999.

Principal Investigator, "Development of a Microprogrammable Computer System based on NCR/32 32-bit Microprocessor Chip Sets," NCR Corporation, 4/1/85 - 3/31/86, $10,400.

Principal Investigator, "Development of the Layered Software for the Digital Image Processing Computer Systems," University of Washington Graduate School, 1/15/85 - 10/15/85, $8,339.

Principal Investigator, "Implementation of the Three-Dimensional Human Body Model," University of Washington Graduate School, 7/1/83 - 6/30/84, $4,300.

Individual Research Program

Mediaprocessor architectures and multimedia systems.

Distributed diagnosis and home healthcare.

Ultrasound imaging.

Multimodality image analysis and processing.

Applications in medical imaging, telemedicine and medical informatics.

Pipelined and parallel processing computer architecture for imaging and 3-D graphics.

Image & video compression.

Digital imaging network and picture archiving & communications system (DIN/PACS).

Computer modeling based on finite element method & experimental techniques to calculate electric and magnetic field distributions.

Electronic assistive devices for the handicapped.

Pattern recognition & expert system applications in image understanding.

Undergraduate Students Supervised by Y. Kim

Every BSEE & BSCompE student has done an individual project and written a report.

1. Gary Shankman (BSEE, 1983),
2. Mark Westlund (BSEE, 1983)
3. John Gregor (BSEE, 1984),
4. Eric Molver (BSEE, 1984),
5. Mike Upton (BSEE, 1984),
6. Shawn McCutcheon (BSEE, 1985)
7. Jeff McCabe (BSEE, 1985),
8. Gale Paeper (BSEE, 1985)
9. John Ardussi (BSEE, 1985),
10. Ted Kummert (BSEE, 1985)
11. Jeff Reeve (BSEE, 1985),
12. Gerald Simmons (BSEE, 1985)
13. Lien Le (BSEE, 1985),
14. Michael Kahn (BSEE, 1985)
15. Ken Umino (BSEE, 1986),
16. Long Nyuyen (BSEE, 1986)
17. Jocelyn Lum (BSEE, 1986),
18. Sang-Ug Kim (BSEE, 1986)
19. Jean McAuliffe (BSEE, 1986),
20. Doran Akutagawa (BSEE, 1986)
21. Stella Chow (BSEE, 1986),
22. Van Ly (BSEE, 1986)
23. Patty Chinn (BSEE, 1987),
24. Albert Chung (BSEE, 1987)
25. Don Dovey (BSEE, 1987),
26. Jack Poon (BSEE, 1987)
27. Erik Godo (BSEE, 1987),
28. Christine Griffen (BSEE, 1987)
29. Brad Lovering (BSEE, 1987),
30. Karl Mills (BSEE, 1987)
31. David Rubens (BSEE, 1987),
32. Joe Stegman (BSEE, 1987)
33. Bert Sullam (BSEE, 1987),
34. Karl Kleiner (BSEE, 1988)
35. Richard Burton (BSEE, 1988),
36. Allan Weidenheimer (BSEE, 1988)
37. Alison Lytle (BSEE, 1988),
38. Chris Guzak (BSEE, 1988)
39. David Wu (BSEE, 1989),
40. Andrew Nichols (BSEE, 1989)
41. Hsi-Jung Wu (BSCompE, 1989),
42. Daniel Morris (BSEE, 1989)
43. Jeff Schroeder (BSCompE, 1989),
44. Will Cummings (BSEE, 1989)
45. Steve Martin (BSEE, 1989),
46. Steve Bohrer (BSEE, 1989)
47. M. Mojirsheiban (BSEE, 1989),
48. Kurt Sahlin (BSEE, 1989)
49. John Ogden (BSEE, 1989),
50. Larry Wiedenhoft (BSEE, 1990)
51. Greg Stock (BSEE, 1990).
52. Khai Trinh (BSEE, 1990)
53. Kraig Brockschmidt (BSCompE, 1990),
54. John Yeh (BSEE, 1990)
55. Anthony Hawkins (BSEE, 1990),
56. Anthony Wong (BSEE, 1990)
57. Radwan Faraj (BSEE, 1990),
58. Alex Umino (BSEE, 1991)
59. Jon Chinn (BSEE, 1991),
60. Wilfred Wong (BSEE, 1991)
61. Adam Lew (BSEE, 1991),
62. Doug Nakano (BSEE, 1992)
63. Vicki Yee (BSEE, 1992),
64. Brian Read (BSEE, 1993)
65. Chris Dobbs (BSEE, 1995),
66. Edwards Kaetz (BSEE, 1995)
67. Myeong Lee (BSEE, 1996)
68. Peter Mattson (BSEE, 1997)
69. Grant Kobayashi (BSEE, 1999)
70. Janice Kim (BSE, 2001)
71. Dominic Wu (BSEE, 2003)
72. Travis Wilkins (BSEE, 2003)
73. Jai Modai (BSCompE, 2004)

Mary Gates Scholars

1. Peter Mattson
2. Grant Kobayashi
3. Janice Kim

Barry M. Goldwater Scholar

1. Janice Kim

MS Degrees Supervised by Y. Kim

Every student (MSEE and MSBIOEN) has written his/her Master's thesis.

1. Ruey-Fong Yen (MSEE, 4/84)
2. Hok-Wai Woo (MSEE, 5/84)
3. Mahboob Ahmed (MSEE, 8/84)
4. Brian Hargus (MSEE, 9/84)
5. Ron Timm (MSEE, 11/84)
6. Bill Nicholls (MSEE, 12/84)
7. Anthony Luk (MSEE, 3/85)
8. Brian Buchanan (MSEE, 5/85)
9. Steve Elliott (MSEE, 6/85)
10. Tyler Brooks (MSEE, 6/85)
11. Song Choi (MSEE, 11/85)
12. Paul Mathews (MSEE, 12/85)
13. Paul Yeung (MSEE, 3/86)
14. Scott Schubert (MSEE, 3/86)
15. Ben Fahy (MSEE, 5/86)
16. Hwan Choi (MSEE, 5/86)
17. Tom Alexander (MSEE, 5/86)
18. Brad Tupper (MSEE, 5/86)
19. Dean Verheiden (MSEE, 9/86)
20. Bob Kaucic (MSEE, 1/87)
21. Bob Miyaoka (MSEE, 2/87)
22. Joe Chauvin (MSEE, 2/87)
23. Alan Steiner (MSEE, 2/87)
24. Paul Schimpf (MSEE, 2/87)
25. James Moore (MSEE, 5/87)
26. Paul Budak (MSEE, 5/87)
27. John Blattenbauer (MSEE, 5/87)
28. Peter Jurgens (MSEE, 5/87)
29. Greg Bauer (MSEE, 6/87)
30. David Barnett (MSEE, 10/87)
31. James Turner (MSEE, 2/88)
32. Zhipu Zhu (MSEE, 3/88)
33. Rick Pier (MSEE, 5/88)
34. Heinz-Gunter Zieber (MSEE, 6/88)
35. Grace Bartoo (MSEE, 12/88)
36. Jim Gee (MSEE, 1/89)
37. Patty Chinn (MSEE, 1/89)
38. Woobin Lee (MSEE, 11/89)
39. Paul Wilhelm (MSBIOEN, 12/89)
40. Andy Luedtke (MSEE, 1/90)
41. Karl Mills (MSEE, 3/90)
42. Dawn Blilie (MSBIOEN, 3/90)
43. Gilman Wong (MSEE, 5/90)
44. Clark Haass (MSEE, 6/90)
45. Chi-Shung Wang (MSEE, 6/90)
46. Ramesh Panwar (MSEE, 6/90)
47. Tom Andersen (MSEE, 1/91)
48. Marielena Algorri (MSBIOEN, 6/91)
49. Warren Edwards (MSEE, 8/91)
50. David Yee (MSEE, 8/91)
51. Peng Zhang (MSEE, 2/92)
52. Stuart Milton (MSEE, 5/92)
53. Bingzhong Guan (MSEE, 5/92)
54. Alex Han (MSEE, 5/92)
55. Ed Chen (MSEE, 8/92)
56. Sumeet Agrawal (MSEE, 8/92)
57. Mike Nakahara (MSEE, 3/93)
58. Yuhong Xiong (MSEE, 3/93)
59. Larry Wolfe (MSEE, 3/93)
60. Vikram Chalana (MSBIOEN, 6/93)
61. James Cabral (MSEE, 12/93)
62. David Parsons (MSEE, 12/93)
63. Andrew Alleman (MSEE, 3/94)
64. Jeffrey Reeve (MSEE, 3/94)
65. Nandini Shrinidhi (MSEE, 3/94)
66. Thomas Holcomb (MSEE, 4/94)
67. Joe Young (MSEE, 7/94)
68. Xinyu Wang (MSBIOEN, 7/94)
69. Philip Sinn (MSEE, 12/94)
70. Steve Jantz (MSEE, 12/94)
71. Moots li (MSEE, 12/94)
72. John Bush (MSEE, 5/95)
73. Hao Wu (MSEE, 4/96)
74. Zhong Jin (MSEE, 5/96)
75. Cary Collins (MSEE, 5/96)
76. Sayan Pathak (MSBIOEN, 10/96)
77. Christian DeForge (MSEE, 10/96)
78. Owen Evans (MSEE, 12/96)
79. Liyong Zhou (MSEE, 12/96)
80. Peter Gorgone (MSEE, 7/97)
81. Ann Chamberlain (MSEE, 9/97)
82. Frederic Noraz (MSEE, 8/98)
83. Inga Stotland (MSEE, 12/98)
84. Niko Pagoulatos (MSBIOEN, 12/98)
85. Kevin Hilman (MSEE, 1/99)
86. John Angulo (MSEE, 3/99)
87. Hiroki Mizosoe (MSEE, 3/99)
88. Svetlana Zamberg (MSEE, 6/99)
89. Yoochang Jung (MSEE, 8/99)
90. Todd Schoepflin (MSEE, 8/99)
91. Lakshmanan Gopishankar (MSEE, 4/00)
92. Ken Haberman (MSBIOEN, 8/00)
93. Coskun Mermer (MSEE, 9/00)
94. Rohit Garg (MSEE, 3/01)
95. Michael Grow (MSEE, 6/01)
96. Siddhartha Sikdar (MSEE, 12/01)
97. Kerem Karadayi (MSEE, 3/02)
98. Vijay Shamdasani (MSBIOEN, 6/02)
99. Maikael Thomas (MSEE, 8/02)
100. Anup Agarwal (MSEE, 8/02)
101. Ismail Tutar (MSEE, 3/03)

Ph.D. Degrees Supervised by Y. Kim

1. David Arpin (Ph.D., 5/86), "A parallel processor for the solution of large, sparse symmetric linear systems," in Electrical Engineering, UW.

2. Hok-Wai Woo (Ph.D., 1/90), "Development of a new reconstruction algorithm and an electrical impedance tomography system," in Electrical Engineering, UW.

3. Hwan S. Choi (Ph.D., 7/90), "Partial volume tissue classification of multichannel MRI and its applications - A mixel model," in Electrical Engineering, UW.

4. J. Ben Fahy (Ph.D., 1/91), "A language support system for image processing," in Electrical Engineering, UW.

5. Dean Verheiden (Ph.D., 10/91), "Deterministic scheduling algorithms for distributed image processing," in Electrical Engineering, UW.

6. Larry DeSoto (Ph.D., 11/92), "A three-dimensional distortion model for magnetic resonance images used in image-guided surgery," in Electrical Engineering, UW.

7. Heesub Lee (Ph.D., 12/92), "A classified vector quantization using prediction and its subjective evaluation for X-ray CT images," in Electrical Engineering, UW.

8. Cam Ritchie (Ph.D., 9/93), "Methods for reducing motion artifacts in computed tomography scans of the chest," in Bioengineering, UW.

9. Dawn Blilie Jorgenson (Ph.D., 6/94), "Optimizing current delivery in defibrillation: finite element models and experimental validation," in Bioengineering, UW.

10. Grace Bartoo (Ph.D., 1/95), "Quantitative neuropathologic measures in genetic subgroups of Alzheimers disease," in Bioengineering, UW.

11. Paul Schimpf (Ph.D., 9/95) "Efficient modeling of bioelectric fields," in Electrical Engineering, UW.

12. Jihong Kim (Ph.D., 12/95), "Toward more efficient domain-specific image computing," in Computer Science & Engineering, UW.

13. Vikram Chalana (Ph.D., 6/96), "Deformable models for segmentation of medical ultrasound images," in Bioengineering, UW.

14. Woobin Lee (Ph.D., 4/97), "Architectures and algorithms for MPEG video coding," in Electrical Engineering, UW.

15. Donglok Kim (Ph.D., 9/97), "Extended data cache prefetching using a reference prediction table," in Electrical Engineering, UW.

16. Christopher Basoglu (Ph.D., 9/97), "A generalized programmable system and efficient algorithm for ultrasound backend processing," in Electrical Engineering, UW.

17. Warren Edwards (Ph.D., 6/99), "Three-dimensional ultrasound for clinical applications," in Electrical Engineering, UW.

18. Yanqun Wang (Ph.D., 6/99), "Analysis of defibrillation efficacy and investigation of impedance cardiography with finite element models incorporating anisotropic myocardium," in Bioengineering, UW.

19. George York (Ph.D., 8/99), "Architecture and algorithms for a fully programmable ultrasound

system," in Electrical Engineering, UW.

20. Sayan Pathak (Ph.D., 6/00), "Computer-aided segmentation of anatomical features in transrectal ultrasound prostate images," in Bioengineering, UW.
21. Shijun Sun (Ph.D., 7/00), "Video object segmentation and tracking using VSnakes," in Electrical Engineering, UW.
22. Ravi Managuli (Ph.D., 8/00), "Programmable ultrasound color flow system," in Electrical Engineering, UW.
23. Niko Pagoulatos (Ph.D., 3/02), "Algorithms and systems for registration of two and three-dimensional ultrasound images," in Electrical Engineering, UW.
24. Stefan Berg (Ph.D., 5/02), "A prefetching memory system for mediaprocessor," in Computer Science & Engineering, UW.
25. Chris Chung (Ph.D., 9/02), "Design and evaluation of a multimedia computing architecture based on a 3D graphics pipeline," in Electrical Engineering, UW.
26. Lixin Gong (Ph.D., 12/02), "Ultrasound prostate image segmentation and registration," in Electrical Engineering, UW.
27. Wenfeng Gao (Ph.D., 3/03), "Real-time video postprocessing algorithms and metrics," in Electrical Engineering, UW.
28. Christopher Lau (Ph.D., 8/03), "Systems and methods for patient-centered e-health services," in Bioengineering, UW.
29. Todd Schoepflin (Ph.D., 9/03), "Algorithms for estimating mean vehicle speed using uncalibrated traffic management cameras," in Electrical Engineering, UW.

Research Assistant Professor

Dr. Thomas Alexander, 6/90 - 6/92
Dr. Donglok Kim, 12/97 – 6/01
Dr. Ravi Managuli, 1/01 – 7/03

Visiting Associate Professor

Dr. HyunWook Park, 9/98 – 8/99

Post-Doctoral Research Associates

Dr. HyunWook Park, 7/89 - 3/92
Dr. Min-Hwan Kim, 1/91 - 12/91
Dr. Ja-Il Koo, 3/91 - 3/93
Dr. Chun Sung Kim, 8/92 - 2/93
Dr. Cam Ritchie, 10/93 - 11/94
Dr. Ravi Managuli, 8/00 - 12/00
Dr. Justine Liu, 10/01 - 6/02
Dr. Dong-Gyu Sim, 4/02 -

Research Engineer

Stuart Milton, 5/92 - 4/94

Visiting Scientists

Dr. Kil-Su Eo, 1/90 - 2/92
Dr. Hyung-Sik Choi, MD, 1/92 - 2/93
Yukio Chiba, 4/98 - 12/99
Aikira Tsukui, 4/00 - 9/00
Hitoshi Inoue, 3/01 - 6/01
Tetsuya Hayashi, 4/00 - 4/02
Dr. Atsutaka Okizaki, 6/03 – 6/04
Dr. Sosuke Miyoshi, 3/03 -

Visiting Scholars

Ikuo Tsukagoshi, 9/87 - 9/88
Jae-Jeong Jong, 8/91 - 8/92
Nam-Geol Lee, 8/91 - 12/92
Hak-June Kim, 7/92 - 3/94
Takashi Kameya, 8/03 – 9/04
Jin-Ryong Yoo, 8/03 – 7/04

Visiting Graduate Students

Christian DeForge from IRESTE (Nantes, France), 1/94 - 6/94
Frederic Noraz from IRESTE (Nantes, France), 1/96 - 6/96
Kristell Villalard from IRESTE (Nantes, France), 1/98 - 6/98

PUBLICATIONS

Journal Articles

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b. Abstracts

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SERVICE ACTIVITIES

Department

Member of the Graduate Study Committee, 1982-1984.
Member of the Graduate Admissions Subcommittee, 1982-1984.
Member of the Graduate Financial Aid Subcommittee, 1982-1984.
Member of the Computer Engineering Faculty Search Committee, 1983.
Member of the Undergraduate Admissions Appeals Committee, 1983-1986.
Chairman of the Undergraduate Admissions Appeals Committee, 1984.
Member of the Computer Engineering Faculty Search Committee, 1984-1985.
Member of the Undergraduate Admissions Committee, 1986, 1987.
Member of the Support Services & Facilities Committee, 1984-1987.
Set up the Advanced Microprocessor Laboratory (Intel 8086's, Motorola's 68000's, National 32016's, and their development facilities), 1984-1987.
Faculty Supervisor of the EE Stockroom, 1985-1990.
Member of the Ad Hoc Undergraduate Curriculum Review Comm., 1986-1987.
Member of the Electrical Engineering Faculty Search Committee, 1986-1987.

Member of the Computer Engineering Faculty Search Committee, 1987-1988.
Member of the Development Committee, 1987-1988.
Chairman of the Undergraduate Admissions Committee, Spring, 1988.
Chairman of the Undergraduate Admissions Appeals Committee, Fall, 1988.
Chairman of the Computer Engineering Faculty Search Committee, 1988.
Chairman of the Electrical Engineering Faculty Search Committee, 1988-1990.
Chairman of the Merit Review Committee for Assistant Professors, 1989.
Member of the EE/CSE Curriculum Coordination Committee, 1990.
Member of the EE Departmental Building Committee, 1989-1990.
Chairman of the EE Strategic Planning Committee, 1990-1991.
Member of the EE Department Advisory Committee, 1990-1991, 1995-1996.
Member of the Neopath Professorship Search Committee, 1995-1996.
Chair of the Neopath Professorship Search Committee, 1996-1998.
Chair of the EE Computers Group, 1995-1996.
Member of the Electrical Engineering Faculty Search Committee, 1996-1997.
Set up the Digital Electronics and Computer Design Laboratory in 1984.
Set up the Image Computing Systems Laboratory (ICSL) in 1984 and in charge of it.
Chair of the Bioengineering Faculty Search Committee, 1999-2002.
Chair of the Bioengineering Graduate Admissions Committee, 1999-2001.

College & University

Member of the Advisory Group for Pathology Image Analysis Laboratory, 1984- 1989.
Member of the Advisory Board for Engineering Continuing Education, 1987-1988.
Member of the Ad Hoc Committee on Supercomputing in Imaging, 1987-1990.
Member of the Program Committee for the Washington Exhibition of Science & (WEST-88), 1988.
Member of the Washington Technology Center Advisory Committee on Computer Systems and Software, and the WTC Long Range Research Planning Committee, 1988-1989.
Member of the EE Chairman Search Committee, 1988-1989.
Member of the proposal writing team for the NSF Engineering Research Center on Imaging Systems Optimization, 1989-1990.
Interim Director of the Center for Imaging Systems Optimization (CISO), 1991.
Member of the Engineering Courses Committee, 1989-1992.
Chairman of the College Courses Committee VIII (ENGR 275), 1989-1992.
Member of the UW Interdisciplinary Research Committee, 1991-1992.
Member of the Executive Committee for Center for Imaging Systems Optimization, 1990-1993.
Member of the UW Provost Search Committee, 1993.
Member of the Classified & Proprietary Research Committee, 1994-1995.
Member of the Executive Committee for the Diagnostic Imaging Sciences Ctr. (DISC), 1991-1996.
Member of the Advisory Committee on Medical Informatics, 1995.
Member of the UW Provost Search Committee, 1995-1996.
Chairman of the Bioengineering Chair Search Committee, 1996-1997.
Member of the Medical School Admissions Committee, 1999-2000.
Member of the School of Medicine Executive Committee, 1999-
Member of the College of Engineering Executive Committee, 1999-
Member of the UW Vice President for Minority Affairs Search Committee, 2000-2001.
Member of the UW Law School LL.M. Program Review Committee, 2001-2002.
Member of the Radiology Chair Search Committee, 2001-2002.
Member of the School of Medicine research Planning Committee, 2002-
Founder and Director of the C80 University of Washington Image Computing Library Consortium, 1994-1997.
Founder and Director of the MAP University of Washington Image Computing Library Consortium, 1999-
Founder and Director of the UW Mediaprocessor User Consortium, 2000-2002.

Founder and Director of the C64 University of Washington Image Computing Library Consortium, 2001-

Editorial Boards

Member, Editorial Board of the *Journal of Multimedia Tools and Applications*, 1994-1998.
Member, Editorial Board of the *Telemedicine Journal*, 1995-2001.
Member, Editorial Board of the *IEEE Press Series in Biomedical Engineering*, 1996-
Member, Advisory Board of the *IEEE Transactions on Biomedical Engineering*, 1996-
Member, Editorial Board of the *IEEE Transactions on Information Technology in Biomedicine*, 1996-
Member, Editorial Board of the *Annual Reviews of Biomedical Engineering*, 1997-2002.
Member, Editorial Board of the *Proceedings of the IEEE*, 2002-
Guest Editor, *Parallel Computing*, 1997-1998.
Guest Editor, *International Journal of Imaging Systems & Technology*, 1997-1998.

Professional Societies

Fellow of the IEEE and member of
- IEEE Computer Society
- IEEE EMB Society
- IEEE Education Society
- IEEE Signal Processing Society
- IEEE Circuits and Systems Society

Fellow of the American Institute of Medical and Biological Engineering (AIMBE)
Member of SPIE (International Society for Optical Engineering)
IEEE/ABET (Accreditation Board for Engineering and Technology) Program Evaluator of Bioengineering and Computer Engineering, 1992-
Chairman, IEEE *Transactions on Medical Imaging* Steering Committee, 1993-1994.
Chairman, IEEE *Transactions on Medical Imaging* Editor-in-Chief Search Committee, 1994.
Member of the Administrative Committee of the IEEE Engineering in Medicine and Biology Society, Jan. '95 - Dec. '99 and Jan. '02–Dec. '04.
Chairman, IEEE/EMBS Distinguished Lecturers Committee, 1997-1999.
Chairman, IEEE/EMBS Awards Committee, 2001-2002.
Chairman, IEEE/EMBS Fellow Committee, 2003-
Member of the IEEE/EMBS Publications Committee, 1995-1999, 2002-
Member of the IEEE/EMBS Finance Committee, 1995-1999, 2002-
Member, *IEEE Transactions on Biomedical Engineering* Editor-in-Chief Search Committee, 1996.
Member, *IEEE Transactions on Biomedical Engineering* Editor-in-Chief Search Committee, 2000.
Member of the IEEE Fellow Committee, 1998-2001.
President-Elect of the IEEE Engineering in Medicine and Biology Society (EMBS), 2004.

Awarded the Early Career Achievement Award of the IEEE Engineering in Medicine and Biology Society for his contributions to the fields of medical imaging, signal processing for biomedical applications, electrical impedance tomography and tissue modeling, Nov. 1988.

Co-Chaired the session, "Microprocessor-based instrumentation: hardware and software" in the Fifth Annual IEEE/EMBS Conference, Sept. 1983.

Organized and chaired the session, "Electrosurgery and Dispersive Electrodes," in the AAMI 19th Annual Meeting in Washington, D.C., April 1984.

Organized and presented the 3-hour workshop, "Advanced Microprocessors for Biomedical Engineering Applications," in the Sixth Annual IEEE/EMBS Conference in Los Angeles, Sept. 1984.

Chaired the session, "System Architecture," in Mini and Microcomputers in Control, Filtering and Signal Processing Conference, in Las Vegas, Dec. 1984.

Organized and chaired the session "Biomedical Image Processing Computer Systems," in the Seventh Annual IEEE/EMBS Conference in Chicago, Sept. 1985.

Organized and taught a short course, "Computer Hardware/Software Systems for Image Processing," in the Seventh Annual IEEE/EMBS Conference in Chicago, Sept. 1985.

Member of the technical program committee for the Seventh Annual IEEE/EMBS Conference in Chicago, Sept. 27-30, 1985.

Chaired the session "Image Processing/Pattern Recognition," in the Software and Hardware Applications of Microcomputers Conference in Beverly Hills, CA, Feb. 5-7, 1986.

Member of the international program committee for the Software and Hardware Applications of Microcomputers Conference in Beverly Hills, CA, Feb. 5-7, 1986.

Chaired the session, "Image Processing V," in the SPIE Medical Imaging Conference in Newport Beach, CA, Feb. 1-6, 1987.

Finance Chairman of the 1987 Workshop on Computer Architecture for Pattern Analysis and Machine Intelligence, Oct. 5-8, 1987.

Co-Chaired the session, "Image Processing," in the Washington Exhibition of Science and Technology (WEST-88), Oct. 1988.

Chaired the session, "Image Processing II," in the Tenth Annual IEEE/EMBS Conference in New Orleans, Nov. 1988.

Member of the organizing committee for the First International Conference on Image Management and Communication in Patient Care: Implementation and Impact (IMAC-'89), Washington, D.C., June 1989.

Chaired the Image Technology Workshop in the IMAC-'89 Conference, Washington, D.C., June 1989.

Program Chairman of the Eleventh Annual International Conference of the IEEE/EMBS (in charge of organizing more than 1,000 papers, 180 sessions, 23 tracks), Nov. 1989. Acknowledged by the IEEE/EMBS President, "for his perception of quality and his unflagging dedication to produce a comprehensive and outstanding technical program for the 1989, 11th Annual International Conference of the IEEE/EMBS".

Chairman of the Bioelectric Potentials Track with 8 sessions in the Eleventh Annual International Conference of the IEEE/EMBS, Nov. 1989.

Member of the IEEE TAB (Technical Activities Board) New Ventures Committee, 1990.

Member of the Program Committee for the SPIE Medical Imaging Conference in Newport Beach, CA, Feb. 1990.

Chaired the session, "Workstations," in the SPIE Medical Imaging Symposium in Newport Beach, CA, Feb. 1990.

Conference Co-Chairman of the SPIE Medical Imaging Symposium (in charge of Image Capture and Display Conference, Vol. 1232) in Newport Beach, CA, Feb. 1990.

Chaired the workshop, "Image Computing Systems," at the UW College of Engineering Corporate Associates Day, Seattle, WA, April 1990.

Chaired the session, "Image Processing," in the Twelfth Annual International Conference of the IEEE/EMBS, Nov. 1990.

Member of the SPIE Medical Imaging Technical Organizing Committee for the 1991 Conference in San Jose, CA, Feb. 1991.

Chairman of the SPIE Image Capture, Formatting, and Display Conference in San Jose, CA, Feb. 1991.

Chaired the session, "Workstations," in the SPIE Medical Imaging Conference in San Jose, CA, Feb. 1991.

Member of the organizing committee for the Second International Conference on Image Management and Communication in Patient Care: New Technology for Better Patient Care (IMAC-'91), Kyoto, Japan, April 1991.

Presented a 3-hour minicourse, "Advances in Image Processing ICs," in the Electronic Imaging West '91 Conference in Anaheim, CA, April 1991.

Chaired the session, "Parallel Processing," in the IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, Victoria, B.C., May 1991.

Selected as one of the IEEE/EMBS Distinguished Lecturers, 1991.

Presented a 3-hour minicourse, "Advances in Image Processing ICs," in the Electronic Imaging East '91 Conference in Boston, MA, Sept. 1991.

Chairman of the SPIE Image Capture, Formatting, and Display Conference in Newport Beach, CA, Feb. 1992.

Organized and was keynote speaker of a workshop, "Medical Imaging Workstations" at the SPIE Medical Imaging VI in Newport Beach, CA, Feb. 1992.

Chaired the session, "New ICs for Image Processing," in the Electronic Imaging West '92 Conference in Anaheim, CA, March 1992.

Presented a 3-hour minicourse, "Advances in Image Processing ICs," in the Electronic Imaging West '92 Conference in Anaheim, CA, March 1992.

Member of the NIH site visit team to the Bowman Gray Medical Center, Winston Salem, NC, March 1992.

Chaired the session, "Workstations," in the Symposium for Computer Assisted Radiology (S/CAR) in Baltimore, MD, June 1992.

Member of the NSF Proposal Review Panel, Washington, D.C., Sept. 1992.

Member of the ABET Accreditation Visit Team to University of Texas at Austin, Oct. 1992.

Member of the Conference Committee for the IEEE/EMBS 14th Annual International Conference, Paris, France, Oct. 1992.

Exhibit Co-Chair for the IEEE/EMBS 14th Annual International Conference, Paris, France, Oct. 1992.

Co-Chair of the PACS topic area for the IEEE/EMBS 14th Annual International Conference, Paris, France, Oct. 1992.

Invited speaker at the "Tutorials: Frontiers of Computers in Biomedical Engineering" during the IEEE/EMBS 14th Annual International Conference, Paris, France, Oct. 1992.

Chairman of the SPIE Image Capture, Formatting, and Display Conference in Newport Beach, CA, Feb. 1993.

Organized and was keynote speaker of a workshop, "Multimedia Systems in Medicine" at the SPIE Medical Imaging VII in Newport Beach, CA, Feb. 1993.

Member of the NSF-sponsored Planning Workshop on Computer Assisted Surgery, Washington, D.C., Feb. 1993.

Member of the ABET Accreditation Visit Team to University of Missouri-Columbia, Oct. 1993.

Chairman of the SPIE Image Capture, Formatting, and Display Conference, and chaired a session on "Multimedia in Medical Imaging" in Newport Beach, CA, Feb. 1994.

Organized and chaired the workshop, "Virtual Reality Applications in Medicine" at the SPIE Medical Imaging Conference in Newport Beach, CA, Feb. 1994.

Invited speaker at the CeBit Conference in Hannover, Germany, March 22, 1994.

Member of the International Advisory Board for the IEEE-EMBS International Summer School on 3-Dimensional Biomedical Imaging, Univ. de Rennes, France, July 2-10, 1994.

Member of the Program Committee for the First International Symposium on Medical Robotics and Computer Assisted Surgery, Pittsburgh, PA, Sept. 1994.

Invited speaker at the SPIE Critical Review on Defining the Global Information Infrastructure, Boston, MA, Nov. 1994.

External reviewer of the graduate program on Biomedical Physics at UCLA, Nov. 1994.

Member of the ABET Accreditation Visit Team to Northwestern Polytechnic University, Nov. 1994.

Chairman of the Image Display Conference, SPIE Medical Imaging, San Diego, CA, Feb. 1995.

Chair of the session, "Issues in Image Displays," SPIE Medical Imaging Conference, San Diego, CA, Feb. 1995.

Organized and chaired the workshop, "Multimedia Applications in Telemedicine," SPIE Medical Imaging Conference, San Diego, CA, Feb. 1995.

Invited speaker at the AAAS Workshop on Fundamental Issues of Imaging Science, Atlanta, GA, Feb. 16-17, 1995.

Invited speaker at the National Forum: Military Telemedicine On-Line Today, "Research, Practice and Opportunities," McLean, VA, March 1995.

Chair of the session on "Desktop Video Conferencing: Chips, Boards and Applications" at the DSP_X '95 Conference, San Jose, CA, May 15-18, 1995.

Tutorial on Multimedia Technologies and Systems at the IEEE International Conference on Communications, Seattle, WA, June 22, 1995.

Member of the Program Committee for the Fourth International Conference on Image Management and Communication (IMAC 95), Oahu Island, Hawaii, August 1995.

Organized and chaired the one-day TMS320C80 Developers' Conference at the University of Washington, Sept. 15, 1995.

Member of the Program Committee for the SPIE 1995 Symposium on Information, Communications and Computer Technology, Applications and System, Philadelphia, PA, Oct. 1995.

Member of the Program Committee for the Second International Symposium on Medical Robotics and Computer Assisted Surgery, Baltimore, MD, Nov. 1995.

External Reviewer for the Biomedical Imaging Program at University of Virginia, Charlottesville, Nov. 1995.

Chairman of the Image Display Conference, SPIE Medical Imaging, Newport Beach, CA, Feb. 1996.

Organized the workshop, "Multimedia and Information Superhighway in Telemedicine," SPIE Medical Imaging, Newport Beach, CA, Feb. 1996.

Chair of the session, "Multimedia, Virtual Reality, and Telemedicine," SPIE Medical Imaging Conference, Newport Beach, CA, Feb. 1996.

Member of the NIH site visit team to the University of Texas Health Science Center at San Antonio, July 1996.

Member of the Technical Program Committee for the 1996 International Conference on Image Processing, Lausanne, Switzerland, Sept. 1996.

Chairman of the Image Display Conference, SPIE Medical Imaging, Newport Beach, CA, Feb. 1997.

Chair of the session, "Three-Dimensional Visualization Systems," SPIE Medical Imaging, Newport Beach, CA, Feb. 1997.

Chair of the session, "Multimedia in Real-Time Medical Image Computing," SPIE Medical Imaging, Newport Beach, CA, Feb. 1997.

Member of the Program Committee for the 1st Joint Conference of CVRMED II and MRCAS III, Grenoble, France, March 1997.

Member of the NIH site visit team to the University of Utah, Salt Lake City, UT, July 1997.

Member of the International Advisory Board for the Information Technology Applications in Biomedicine Conference, Prague, Czech Republic, Sept. 1997.

Chairman of the session, "Multimedia, Display, and Telemedicine," SPIE Medical Imaging, San Diego, CA, Feb. 1998.

Chairman of the session, "Image Hard and Soft Copies," SPIE Medical Imaging, San Diego, CA, Feb. 1998.

Chairman of the Image Display Conference, SPIE Medical Imaging, San Diego, CA, Feb. 1998.

Chairman of the SPIE Medical Imaging Symposium, San Diego, CA, Feb. 1998.

Co-Chairman of the Image Display Conference, SPIE Medical Imaging, San Diego, CA, Feb. 1999.

Chairman of the SPIE Medical Imaging Symposium, San Diego, CA, Feb. 1999.

Session Chair at the IEEE/EMBS, Atlanta, GA, Oct. 1999.

Chairman of the SPIE Medical Imaging Symposium, San Diego, CA, Feb. 2000.

Chairman of the session on "Image Guided Procedures II," at the SPIE Medical Imaging, San Diego, CA, Feb. 2000.

Member of the ABET Accreditation Visit Team to Marquette University, Milwaukee, Oct. 2000.

Chairman of the SPIE Medical Imaging Symposium, San Diego, CA, Feb. 2001.

Chairman of the session on "Clinical Applications I," at the SPIE Medical Imaging, San Diego, CA, Feb. 2001.

Member of the ABET Accreditation Visit Team to University of California, San Diego, Oct. 2001.

Co-Chair of the workshop on Entrepreneurship and Technology Transfer at the Whitaker Foundation Biomedical Engineering Research Conference, San Diego, CA, August 2002.

Co-Chair of the workshop on Industry-Sponsored Research at the Whitaker Foundation Biomedical Engineering Research Conference, San Diego, CA, August 2002.

Co-Chair of the Imaging Theme in the IEEE/EMBS Annual Conference, Cancun, Mexico, Sept. 2003.

Session Chair at the IEEE/EMBS, Cancun, Mexico, Sept. 2003.

Member of the ABET Accreditation Visit Team to Boston University, Boston, Oct. 2003.

Co-Chair of the Healthcare Information Technology Theme in the IEEE/EMBS Annual Conference, San Francisco, Sept. 2004.

Chair of three sessions in the IEEE/EMBS Annual Conference, San Francisco, Sept. 2004.

Member of the Whitaker Foundation site visit team to Columbia University on 12/9/04.

Member of the Cleveland Clinic Foundation Department of Biomedical Engineering External Advisory Board since 1996.

Member of the University of Wisconsin Department of Biomedical Engineering External Advisory Board since 2000.

Member of the Electronic Imaging Technical Advisory Board, 1991-1992.

Member of the SDI Biomedical Technology Application Review Panel, 1992-1993.

Member of the Advisory Board & IEEE/EMBS Representative to the IEEE Transactions on PAMI (Pattern Analysis and Machine Intelligence), 1985-1995.

Member of the IEEE P610 Computer Dictionary Working Group since 1987.

Member of the Steering Committee for IEEE Transactions on Medical Imaging, 1990-1996.

Reviewed papers since 1982 for the *Proceedings of the IEEE, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Information Technology in Biomedicine, IEEE Transactions on Systems, Man, and Cybernetics, IEEE Transactions on Medical Imaging, IEEE Transactions on Ultrasonics, Ferroelectronics and Frequency Control, IEEE Transactions on Education, IEEE Micro, IEEE EMB Magazine, Optical Engineering, Computer Vision, Graphics, and Image Processing, Journal of Multimedia Tools and Applications, Telemedicine Journal, Real-Time Imaging, International Symposium on Computer Architecture, International Conference on Image Processing, International Journal of Microcomputer Applications, Investigative Radiology, Clinical Physics and Physiological Measurement, Health Devices, Journal of Microwave Power, Encyclopedia of Electrical and Electronics Engineering, and many textbooks.*

Consulting Practice

Consultant, DPMS, Kirkland, WA, 1984.
Consultant, Empirical Research Group, Federal Way, WA, 1984-1985.
Consultant, Samsung Electronics, Seoul, Korea, 1985.
Consultant, Northwest Research Associates, Bellevue, WA, 1985-1987.
Consultant, Levinson, Friedman, Vhugen, Duggan, Bland & Horowitz, Seattle, WA, 1986.
Consultant to review the Clinical Center, National Institutes of Health, Bethesda, MD, 1988.
Consultant, MITRE Corporation, McLean, VA, 1990.
Consultant, Electronics and Telecommunications Research Institute (ETRI), Taejon, Korea, 1988-1990.
Consultant, Neopath, Inc., Seattle, WA, 1989-1990, 1996.
Consultant, Lotte-Canon, Seoul, Korea, 1991.
Consultant, Trinus Partners, Seattle, WA, 1989-1991.
Consultant and member of the Technical Advisory Board, Seattle Silicon, Bellevue, WA, 1990-1991.
Consultant, Samsung Data Systems, Seoul, Korea, 1992.
Consultant, Intel Corporation, Chandler, AZ, 1992.
Consultant, APTEC, Portland, OR, 1992-1993.
Consultant and member of the Board of Directors, Optimedx, Seattle, WA, 1992-1996.
Consultant and member of Scientific Advisory Board, MicroVision Inc., Seattle, WA, 1994-1996.
Consultant, United States Army, 1989-1995.
Consultant, Siemens Medical Systems, Iselin, NJ, 1993-1996.
Consultant, Precision Digital Images Corp., Redmond, WA, 1994-1996.
Consultant, Hitachi, Tokyo, Japan, 1994-
Consultant, Canon, Tokyo, Japan, 1996-2000.
Consultant, Fujitsu, Tokyo, Japan, 1995-1996.
Consultant & member, Scientific Advisory Board, Cable & Howse Ventures, Bellevue, WA, 1995-1996.
Consultant, Perkins Coie, Seattle, WA, 1996.
Consultant, Georgetown University Medical Center, Washington, DC, 1995-2000.
Consultant & member, Scientific Advisory Board, Equator Technologies, Inc., Campbell, CA, 1994-
Consultant, Korean Ministry of Science and Technology, 1999-2000.
Consultant, Micron Technology, Boise, ID, 2000.
Consultant, LizardTech Inc., Seattle, WA, 2000.
Consultant, Amster, Rothstein & Ebenstein, New York, NY, 2000-2002.
Consultant, Streambox Inc., Seattle, WA, 2000-2001.
Consultant, McIntyre & Barns, Seattle, WA, 2001-2002.

Consultant, DNA Inc., Tokyo, Japan, 2001-
Consultant & member, Scientific Advisory Board, Encompass Ventures, Bellevue, WA, 2002-
Consultant, GAIO, Tokyo, Japan, 2002-
Consultant, White & Case, Paolo Alto, CA, 2002-

Patents

"Image Computing System," was filed in June 1990. Patent #5,355,443 was awarded in Oct. 1994.

"Imaging and Graphics Processing System," was filed in Aug. 1991. Patent #5,467,459 was awarded in Nov. 1995. A Korean patent was awarded as well.

"UWGSP4 (An Imaging and Graphics Superworkstation)," was filed in Aug. 1992. A European patent #EP0739513 was awarded in Oct. 1998.

"Ultrasound Signal Processing Apparatus," was filed in Feb. 1995. Patent #5,492,125 was awarded in Feb. 1996.

"Real-Time Ultrasound Scan Conversion," was filed in Aug. 1995. Patent #5,528,302 was awarded in June 1996.

"Method for Controlling the Operation of a Computer Implemented Apparatus to Selectively Execute Instructions of Different Bit Lengths," was filed in March 1993. Patent #5,511,174 was awarded in April 1996.

"Central Processing Unit Data Entering and Interrogating Device and Method Therefor," was filed in July 1993. Patent #5,561,761 was awarded in Oct. 1996.

"Ultrasound System for Automatically Measuring Fetal Head Size," was filed in March 1996. Patent #5,605,155 was awarded in Feb. 1997.

"Self-Defining Instruction Size," was filed in March 1993. Patent #5,673,409 was awarded in Sept. 1997.

"Ultrasound Imaging with Real-Time 3D Image Reconstruction and Visualization," was filed in Feb. 1997. Patent #5,787,889 was awarded in Aug. 1998.

"Pipeline Process for Automatically Measuring Fetal Head Size from Ultrasound Image Samples," was filed in Feb. 1997. Patent #5,795,296 was awarded in Aug. 1998.

"Real Time Color Doppler Ultrasound Imaging," was filed in Feb. 1997. Patent #5,910,117 was awarded in June 1999.

"Pubic Arch Detection and Interference Assessment in Transrectal Ultrasound Guided Prostate Cancer Therapy," was filed Nov. 1998. Patent #6,027,446 was awarded in Feb. 2000.

"Template Matching in 3 Dimensions Using Correlative Auto-Predictive Search," was filed in Dec. 1998. Patent #6,243,494 was awarded in June 2001.

"Color Clustering for Scene Change Detection and Object Tracking in Video Sequences," was filed in Jan. 1999. Patent #6,272,250 was awarded in Aug. 2001.

"Template Matching Using Correlative Auto-Predictive Search," was filed in Dec. 1998. Patent #6,301,387 was awarded in Oct. 2001.

"Motion Estimation within a Sequence of Data Frames Using Optical Flow with Adaptive Gradients," Patent #6,480,615 was awarded in Nov. 2002.

"Interactive Video Object Processing Environment having Zoom Window," Patent #6,525,746 was awarded in Feb. 2003.

"Image Processing in HIS Color Space using Adaptive Noise Filtering," Patent #6,535,632 was awarded in March 2003.

"Video Object Segmentation using Active Contour Modeling with Global Relaxation," Patent #6,546,117 was awarded in April 2003.

"Video Object Tracking Using a Hierarchy of Deformable Templates," Patent #6,574,353 was awarded in June 2003.

"Template Matching Using Correlative Auto-Predictive Search," Patent #6,584,224 was awarded in June 2003.

Patent #6,631,206 was awarded in October 2003.

Patent #6,633,309 was awarded in October 2003.

Patent #6,674,925 was awarded in January 2004.

Patent #6,675,286 was awarded in January 2004.

Patent #6,678,416 was awarded in January 2004.

Patent #6,681,043 was awarded in January 2004.

Patent #6,731,799 was awarded in May 2004.

Patent #6,732,247 was awarded in May 2004.

Patent #6,775,404 was awarded in August 2004.

Patent #6,779,101 was awarded in August 2004.

Patent #6,782,470 was awarded in August 2004.

Patent #6,785,743 was awarded in August 2004.

37 patents issued, about 35 patent applications (including international) are pending.

Invention Disclosures and Technology Transfers

1. Transferred the technology developed in my lab, "Hardware and software development for image processing and computer graphics in IBM PC/AT environment," to Indec Systems, Sunnyvale, CA, in Sept. 1987, through the Office of Technology Transfer of UW. Commercialized. About 500 systems have been sold for biomedical imaging applications including Zeiss confocal microscope's display systems.

2. Disclosed the technology developed in my lab, "An efficient user interface for the PC-based high-

performance imaging workstation," to the Office of Technology Transfer of UW in March 1988.

3. "A high-performance floating point PC-based imaging workstation," in May 1988.

4. "UWGSP3, a high-performance NeXT-based imaging & graphics workstation," in Dec. 1989. A patent application in U.S., Canada, Japan, Korea and Europe was filed and issued in U.S. (#5,355,443). This technology was transferred to Daewoo Telecom Co. in March 1990. Commercialized. About 20 systems have been sold for high-end imaging applications.

5. "UWGSP3-HI: Host-independent image computing workstation," in Sept. 1990.

6. "UWGSP4: An imaging and graphics supercomputer," in Sept. 1990. A patent application in U.S., Japan, Korea and Europe was filed and issued in U.S. (#5,467,459)and Europe (#739,513).

7. "Development of individually tailored 3D thorax models and its application in external and internal defibrillation," in Aug. 1991.

8. "UWGPX: University of Washington graphics accelerator," in April 1991. Three patents were filed in 1993 and subsequently issued (#5,511,174, #5,561,761, and #5,673,409). This technology was transferred to VLSI Technology in 1992.

9. "MultiPlanar Display (MPD) system for image-guided surgery," in Sept. 1992.

10. "GSP5SIM: A simulation environment for MVP-based systems," in June 1993. This technology was transferred to Texas Instruments in Dec. 1993. Commercialized.

11. "UWGSP5: A programmable highly-integrated multimedia system with 2 billion operations per second computing performance," in Nov. 1993. This technology was transferred to Precision Digital Images, and GoldStar in early 1994. Commercialized. About 3000 systems have been sold around the world in imaging and multimedia.

12. "UWGSP8: Development of Image Computing Technologies and their Applications in Ultrasound Imaging," in April 1994. This technology was transferred to Siemens Medical Systems. A patent application in U.S. and Germany was filed and issued in U.S. (#5,492,125). Commercialized. Thousands of our system have been sold.

13. "UW MPEG-1 Codec," in July 1994. This technology was transferred to Radius (Oct. 1994) and Texas Instruments (Jan. 1995). Texas Instruments has sublicensed this to other companies.

14. "Library of Image Computing Routines for Multimedia Video Processor (MVP)" in July 1994. Based on this invention and our continuing R&D efforts, we set up an industry consortium on the UW Image Computing Library in Jan. 1995. So far, eight commercial licenses have resulted from this invention

15. "An Efficient Scan Conversion Algorithm for Ultrasound Machines" in Jan. 1995. A patent application was filed and issued (#5,528,302).

16. "UWGSP7: A Microcomputer-Based System for Real-Time Optical Imaging," in April 1995.

17. "Automatic Fetal Head Size Measurements form Ultrasound Images Using Image Processing Techniques," in Aug. 1995. A patent application was filed and issued (#5,605,155). Commercialized.

18. "MPM: MVP Performance Monitor," in Dec. 1995.

19. "PPS: TMS320C80 Loop Scheduler," in Dec. 1995.

20. "The University of Washington Image Computing Library for HMPV (High-performance Multimedia Processor using VLIW)," in June 1996. Licensed to Hitachi and Xerox.

21. "Interactive Automatic Fetal Head Boundary Detection from Ultrasound Images," in Oct. 1996. A patent application was filed and issued (#5,795,296).

22. "An Efficient Fast Fourier Transform Algorithm for Superscalar and VLIW Processor Architectures," in Oct. 1996.

23. "A Real-Time Algorithm for Generating Color Doppler Ultrasound Images on Programmable Processors," in Oct. 1996. A patent application was filed and issued (#5,910,117).

24. "A Real-Time Three-Dimensional Ultrasound System," in Oct. 1996. A patent application was filed and issued (#5,787,889). Commercialized.

25. "A PC-Based Machine Vision System for Real-Time Computer-Aided Inspection," in Dec. 1996.

26. "Efficient Implementation of Image Warping on a Multimedia Processor," in Dec. 1996.

27. "A Real-Time Color Flow Processing Algorithm on Commercially-Available Microprocessors," in Sept. 1997. A patent application was filed.

28. "Automatic Pubic Arch Detection to Assess the Pubic Arch Interference," in Sept. 1997. A patent application was filed and issued (#6,027,446). Commercialized.

29. "Extended Data Cache Prefetching Using A Reference Prediction Table," in Sept. 1997.

30. "Prostate Boundary Detection and Volume Measurement," in Feb. 1998. A patent application was filed.

31. "Template Matching With Using Correlation Auto-Predictive Search (CAPS)," in April 1998. A patent application in U.S., Japan and Europe was filed and issued in U.S. (#6,301,387). Licensed.

32. "Lossy Compression of Pre-Scan Converted Ultrasound Sequences," in April 1998.

33. "ProSeed: A Tool to Count Seeds in Post-Implant CT Images After Prostate Brachytherapy Treatment," in April 1998.

34. "Template Matching Using Three-Dimensional Correlation Auto-Predictive Search (3D-CAPS)," in April 1998. A patent application in U.S., Japan and Europe was filed and issued in U.S. (#6,243,494). Licensed.

35. "Modified Continuous-Valued Adaptive Resonant Theory (M-ART2) for Color Clustering and Scene Change Detection in Video Sequences," in June 1998. A patent application in U.S., Japan and Europe was filed and issued in U.S. (#6,272,250). Licensed.

36. "Active Contour with Global Relaxation in Video Object Segmentation and Tracking," in Sept. 1998. A patent application in U.S., Japan and Europe was filed. Licensed.

37. "Template Matching Using Multiple-Step CAPS," in Sept. 1998. Licensed. (Incorporated into #31, & #34).

38. "Motion Estimation based on Optical Flow with Adaptive Gradients," in Nov. 1998. A patent application in U.S., Japan and Europe was filed and issued (#6,480,615). Licensed.

39. "An Extensible Framework for Interactive Video Segmentation and Compression," in Dec. 1998. A patent application in U.S., Japan and Europe was filed.

40. "Adaptive Noise Filtering in HSI Color Space," in Dec. 1998. A patent application was filed.

41. "Video Object Tracking in MPEG-4 with a Hierarchy of Deformable Templates," in Jan. 1999. A patent application in U.S., Japan and Europe was filed.

42. "Multimedia Instruction Set for Wide Datapaths," in Feb. 1999. A patent application was filed.

43. "Using Motion-Compensated Frame-Rate Conversion for the Correction of 3:2 Pulldown Artifacts in Video Sequences," in Feb. 1999.

44. "Subinstruction Sharing in VLIW Architectures," in Feb. 1999. A patent application was filed.

45. "Interactive 3D Registration of Ultrasound and Magnetic Resonance Images based on a Magnetic Position Sensor," in Feb. 1999.

46. "Three-dimensional Ultrasound Extended Field of View (3D-XFOV): A Method for Evaluating Large Volumes," in Feb. 1999.

47. "Fast Calibration for 3D Ultrasound Imaging and Multimodality Image Registration," in April 1999.

48. "Template Data Transfer Coprocessor for Mediaprocessors," in May 1999. A patent application was filed.

49. "Postprocessing with Morphology to Improve Object Tracker Robustness," in May 1999. A patent application was filed.

50. "Video Object Segmentation and Tracking Using Vsnakes with Automatic Local Affine Deformation," in May 1999. A patent application in U.S., Japan and Europe was filed.

51. "simCore: A Simulation Library for Efficient Cycle-Accurate Computer System Simulation," in June 1999.

52. "Opcode Compression," in June 1999. A patent application was filed.

53. "Edge Guidance Outlining of Prostate Ultrasound Images with Just-Enough-Interaction," in June 1999.

54. "Generalized Filtering Operations for Hue Image," in July 1999. A patent application was filed.

55. "Architecture and Algorithms for a Fully Programmable Ultrasound Machine," in Aug. 1999.

56. "Transposable Register File," in Aug. 1999. A patent application was filed.

57. "Active Contour Model with Gradient Directional Information: Directional Snake," in Aug. 1999. A patent application in U.S. and Japan was filed.

58. "Vsnakes with Boundary Propagation," in Nov. 1999. A patent application in U.S., Japan and Europe was filed.

59. "Interactive Frame Segmentation with Dynamic Programming," in Jan. 2000. A patent application was filed.

60. "Multi-ported Pipelined Memory," in Jan. 2000. A patent application was filed.

61. "Operand Queues for Streaming Data: A Register File Extension," in Feb. 2000. A patent application was filed.

62. "Ultrasound Image Contrast Enhancement via Integrating Transducer Position Information," in Feb. 2000.

63. "A Framework for Internet-based Home Telemedicine Systems with Multimedia Capabilities," in Feb. 2000.

64. "Video Object Tracking via Background Estimation and Subtraction," in March 2000. A patent application was filed.

65. "Program-directed Cache Prefetching for Mediaprocessors," in Aug. 2000. A patent application was filed.

66. "New Instructions and an Algorithm for Padding in MPEG-4," in Nov. 2000. A patent application was filed.

67. "Mediaprocessor Programming Interface to Increase the Portability of Mediaprocessor Software," in Dec. 2000.

68. "A Method for Boundary Macroblock Padding in an MPEG-4 Video Decoder Utilizing a Graphics Coprocessor," in Jan. 2001. A patent application was filed.

69. "A Programmable 3D Graphics Pipeline for Multimedia Applications," in Feb. 2001. A patent application was filed.

70. "Programmable Ultrasound Scan Conversion on a Mediaprocessor-based System," in Mar. 2001.

71. "A Method to Better Utilize Deep-Pipelined Architectures by Eliminating Setup and Pipeline Delays," in Jan. 2002.

72. "University of Washington Image Computing Library for Texas Instruments TSM320C64x," in May 2002.

73. "Adaptive Clutter Filtering for Ultrasound Color Flow Imaging," in Dec. 2002.

74. "Personal Health Information Management System and Facilitated Accurate Referral management," in March 2003.

75. "Architecture and Algorithms for a Programmable Ultrasound Machine," in June 2003. Licensed.

76. "Transcutaneous Localization of Internal Bleeding by Two-dimensional Ultrasonic Imaging of Tissue Vibrations," in Oct. 2003.

77. "Method and Apparatus for a Low-cost, Reconfigurable, and Programmable Receive Beamformer," in Jan. 2004.

78. "Ultrasound Imaging Method and Apparatus using Coded Excitation with Efficient Transmit Power Coding and 2-Stage Pulse Compression," in Feb. 2004.

79. "Method and Apparatus for a Home Ultrasound System," in Feb. 2004.

80. "Ultrasound Technique for Assessing Wall Vibrations in Stenosed Arteries," in March 2004.

Professional Presentations

Guest speaker on 2/5/83 at the Tau Beta Pi Initiation Banquet, South Campus HUB, UW.

Seminar on 7/2/84 at Purdue University, West Lafayette, IN.

Invited speaker in the tutorial, "Medical Applications of Microprocessors," in the AAMI Regional Meeting in Portland, OR, October 1-3, 1984.

Seminar on 10/12/84 at Electrical Engineering EE 599B, UW.

Seminar on 11/21/84 at Bioengineering BIOEN 510, UW.

Seminar on 5/6/85 at Seoul National University, Seoul, Korea.

Seminar on 5/7/85 at KAIST (Korean Advanced Institute of Science and Technology), Seoul, Korea.

Seminar on 11/13/85 at Bioengineering BIOEN 510, UW.

Presentation on 11/14/85 at "A Symposium in Instructional Computing", UW.

Seminar on 12/2/85 at Sheffield University, Sheffield, England.

Seminar on 12/5/85 at University of Duisburg, Duisburg, West Germany.

Seminar on 3/31/86 at Department of Aeronautics and Astronautics, UW.

Seminar on 4/15/86 at Northwestern University, Evanston, IL.

Seminar on 4/17/86 at MIT, Cambridge, MA.

Seminar on 4/18/86 at National Institutes of Health, Bethesda, MD.

Invited speaker at the Conference, "Medical Bioelectric Impedance - State of the Art, Indianapolis, IN, June 13-14, 1986.

Seminar on 6/16/86 at University of Illinois, Urbana-Champaign, IL.

Seminars on 6/30/86 and 7/1/86 at University of Nantes, Nantes, France.

Invited speaker at the European Community Workshop on Electrical Impedance Imaging in Sheffield, England, July 2-4, 1986.

Seminar on 9/29/86 at Electrical Engineering EE 590D, UW.

Seminar on 10/29/86 at Bioengineering BIOEN 510, UW.

Seminar on 11/20/86 at Department of Computer Science, UW.

Seminar on 1/13/87 at B. C. Cancer Research Center, Vancouver, Canada.

Seminar on 2/2/87 at Electrical Engineering EE 599B, UW.

Seminar on 2/12/87 at University of California, Irvine, CA.

Seminar on 3/25/87 at AT&T Bell Laboratories, Middletown, NJ.

Invited speaker on 6/10/87 at the Texas Instruments 1987 Graphics Solution Seminar, Bellevue, WA.

Invited speaker in the Continuing Medical Education Course, "Computer Graphics in Medicine and Surgery," Virginia Mason Medical Center, Seattle, WA, June 26, 1987.

Invited speaker in Electrical Engineering Symposium at the IBM ACIS University Conference in Boston, June 27-30, 1987.

Demonstrated the image processing workstation (UWGSP#1) developed in my lab at the IBM ACIS University Conference in Boston, June 28-29, 1987.

Demonstrated UWGSP#1 at the Siggraph '87 Conference in Anaheim, CA, July 28-30, 1987.

Demonstrated UWGSP#1 at the Annual Review of Neurosurgery in Seattle, WA, Oct. 15-17, 1987.

Demonstrated UWGSP#1 at the COMDEX Fall '87 Conference in Las Vegas, Nov. 3-4, 1987.

Invited speaker at the IBM Conference on Academic Computing, Berkeley, CA, Nov. 14, 1987.

Seminar on 11/13/87 at IBM Scientific Center, Palo Alto, CA.

Seminar on 11/16/87 at BBN Laboratories, Cambridge, MA.

Seminar on 12/1/87 at Bioengineering BIOEN 299, UW.

Seminar on 1/25/88 at Electrical Engineering EE500B, UW.

Seminar on 1/28/88 at University of Virginia, Charlottesville, VA.

Seminar on 2/24/88 at Bioengineering BIOEN 510, UW.

Invited speaker at the IEEE Computer Society of United Kingdom and Republic of Ireland Chapter Meeting on Computing in Medicine, March 3, 1988, Imperial College, London, England.

Demonstrated UWGSP#1 at the Reception featuring authors of University-sponsored software and their products in Seattle, WA, March 17, 1988.

Presentation at the UW College of Engineering Visiting Committee, April 21, 1988.

Seminar on 5/18/88 at the Harborview Medical Center, Seattle, WA.

Seminars on 6/20, 6/21 and 6/22/88 at ETRI (Electronics and Telecommunications Research Institute), Taejon, Korea.

Seminar on 6/23/88 at Yonsei University, Seoul, Korea.

Seminar on 6/24/88 at Seoul National University Hospital, Seoul, Korea.

Seminar on 6/25/88 at KAIST (Korean Advanced Institute of Science and Technology), Seoul, Korea.

Seminar on 7/6/88 at POSTECH (Pohang Institute of Science & Technology), Pohang, Korea.

Seminar on 7/8/88 at Seoul National University Department of Computer Engineering, Seoul, Korea.

Seminar on 7/11/88 at Sony Research Center, Tokyo, Japan.

Seminar on 7/12/88 at Toshiba Medical Engineering Laboratory, Otawara, Japan.

Demonstrated the floating-point image processing workstation (UWGSP#2) developed in my lab at the Siggraph '88 Conference in Atlanta, GA, Aug. 2-4, 1988.

Seminar on 8/19/88 at University of Wisconsin, Madison, WI.

Seminar on 9/26/88 at Electrical Engineering EE500B, UW.

Invited speaker in the Image Processing Session of the Washington Exhibition of Science and Technology (WEST-88), Oct. 17, 1988.

Seminar on 11/15/88 at Bioengineering BIOEN 299, UW.

Seminar on 12/1/88 at Texas Instruments Central Research Lab, Dallas, TX.

Seminar on 1/25/89 at Bioengineering BIOEN 510, UW.

Presentation on 2/28/89 at the Computer Science Annual Affiliate Day, UW.

Seminar on 3/22/89 at KAIST (Korean Advanced Institute of Science and Technology), Seoul, Korea.

Invited speaker on 4/4/89 at the Duke University's NSF Engineering Research Center for Emerging Cardiovascular Technologies' Spring Workshop, Durham, NC.

Seminar on 4/13/89 at University of Southern California, Los Angeles, CA.

Seminar on 4/21/89 at University of Arizona, Tucson, AZ.

Seminar on 5/25/89 at Department of Computer Science CS 599, UW.

Seminar on 9/21/89 at ETRI (Electronics and Telecommunications Research Institute), Taejon, Korea.

Seminar on 9/25/89 at Electrical Engineering EE500B, UW.

Invited speaker on 10/31/89 at Lawrence Berkeley Lab in the Imaging Symposium, Berkeley, CA.

Invited speaker on 11/7/89 at University of Victoria in the Executive Symposia on Telehealth, Victoria, B.C.

Invited speaker on 11/14/89 at the Technology Transfer Breakfast, Rainier Club, Seattle, WA.

Demonstrated the UWGSP3 System developed in my lab at the SPIE Medical Imaging in Newport Beach, CA, Feb. 4-9, 1990.

Seminar on 2/26/90 at Electrical Engineering EE500B, UW.

Seminar on 3/7/90 to the Radiology Faculty, UW.

Seminar on 3/13/90 at KAIST (Korean Advanced Institute of Science and Technology), Seoul, Korea.

Seminar on 3/15/90 at ETRI (Electronics and Telecommunications Research Institute), Taejon, Korea.

Demonstrated the UWGSP3 System at the UW Computer Fair in Seattle, WA, March 14-15, 1990.

Demonstrated the USGSP3 System at the National Computer Graphics Association (NCGA) '90 Conference in Anaheim, CA, March 19-22, 1990.

Seminar on 3/23/90 at NeXT, Redwood City, CA.

Held a Press Conference on 3/29/90 on the UWGSP3 System at the University of Washington, Seattle, WA.

Seminar on 4/5/90 at Department of Computer Science and Engineering, UW.

Seminar on 4/16/90 at Boeing, Bellevue, WA.

Presentation on 4/19/90 at the UW College of Engineering Corporate Associate Day, Seattle, WA.

Seminar on 4/24/90 at the MIT Media Lab, Cambridge, MA.

Seminar on 4/25/90 at Naval Research Laboratory, Washington, D.C.

Seminar on 4/26/90 at IBM, Atlanta, GA.

Demonstrated the UWGSP3 System on 4/27 - 4/28/90 at UW Engineering Open House, Seattle, WA.

Seminar on 5/8/90 at Boeing, Kent, WA.

Seminar on 5/25/90 at the University of Washington Medical Center, UW.

Demonstrated the UWGSP3 System at COMDEX '90 Spring in Atlanta, GA, June 3-6, 1990.

Seminar on 6/12/90 at the 3M Advanced Media and Systems Center, St. Paul, MN.

Invited speaker on 6/12/90 at the Univ. of Minnesota Supercomputer Institute, Minneapolis, MN.

Seminar on 6/13/90 at the Physio Control Workshop on Electric Current Pathways in the Human Thorax, Silverdale, WA.

Seminar on 7/2/90 at ETRI (Electronics and Telecommunications Research Institute), Taejon, Korea.

Seminar on 7/4/90 at the Riviera Hotel, Taejon, Korea.

Seminar on 7/4/90 at KAIST (Korean Advanced Institute of Science and Technology), Seoul, Korea.

Seminar on 7/5/90 at Seoul National University, Seoul, Korea.

Held a Press Conference on 7/6/90 on the UWGSP3 system at the Hilton Hotel, Seoul, Korea.

Demonstrated the UWGSP3 System at the Siggraph '90 Conference in Dallas, TX, Aug. 7-9, 1990.

Seminar on 8/10/90 at Texas Instruments Central Research Laboratory, Dallas, TX.

Keynote speaker on 9/22/90 at the general assembly of the Korean Association of Physicists in Medicine, Seoul, Korea.

Seminar on 10/1/90 at Electrical Engineering EE500B, UW.

Demonstrated the UWGSP3 System at the UW Engineering Homecoming Open House & Tailgate Party on 10/27/90, and at the UW College of Engineering Annual Scholarship/Fellowship Awards Reception on 11/20/90.

Seminar on 11/7/90 at the Statistics Visualization Seminar Series, UW.

Invited speaker at the InCom '90 International Workshop, Nov. 28-29, 1990, Taejon, Korea.

Seminar on 2/28/91 at Siemens Ultrasound, San Ramon, CA.

Grand Round speaker at the Department of Laboratory Medicine of the University of Washington Medical Center, March 13, 1991.

Seminar on 3/28/91 at Seoul National University, Seoul, Korea.

Invited speaker at the IBM Medical Imaging Workshop, March 29-30, 1991, Seoul, Korea.

Seminar on 4/1/91, Korea Telecommunications Authority, Seoul, Korea.

Seminar on 4/3/91, Chungnam National University, Taejon, Korea.

Seminar on 4/8/91, Sony Central Research Lab, Tokyo, Japan.

Seminar on 4/9/91, Oki Electric Industry, Tokyo, Japan.

Seminar on 4/10/91, IBM-Japan, Tokyo, Japan.

Invited speaker at the Second International Conference on Image Management and Communication in Patient Care: New Technology for Better Patient Care (IMAC- '91), April 10-13, 1991, Kyoto, Japan.

Seminar on 5/17/91, Department of Radiology, UW.

Invited speaker at the Strategic Defense Initiative (SDI) Technology Transfer Forum, May 21-22, 1991, Washington, DC.

Seminar on 5/28/91, Korea Institute of Construction Technology, Seoul, Korea.

Seminar on 5/31/91, Asan Medical Center, Seoul, Korea.

Invited speaker at the Multimedia Computing Technology Workshop, May 29-30, 1991, Seoul, Korea.

Seminar on 6/25/91, Institute of Systems Science, National University of Singapore, Singapore.

Seminar on 6/27/91, Institute of Systems Science, National University of Singapore, Singapore.

Invited speaker on 7/1/91, IEEE Computer Chapter Hong Kong Section, Hong Kong.

Seminar on 7/5/91, Advanced Defense Development, Taejon, Korea.

Seminar on 7/8/91, POSTECH (Pohang Institute of Science & Technology), Pohang, Korea.

Visiting Professor for 7/8 - 7/10/91 at POSTECH, Pohang, Korea.

Presentation on 9/14/91, Dr. John W. Loop Memorial Lecture, UW.

Invited Speaker at the International Conference on Computers in Clinical Dentistry, 9/27/91 - 9/29/91, Houston, TX.

Seminar on 10/1/91, IBM T. J. Watson Laboratory, Hawthorne, NY.

Saturday Morning Pre-football Game Seminar on "Images of the 21st Century," 10/12/91, UW University Relations.

Seminar on 10/21/91 at Electrical Engineering EE500B, UW.

Invited speaker on 11/1/91 at the Symposium on Medical Informatics during the IEEE/EMBS 13th Annual International Conference, Orlando, FL.

Invited speaker on 11/5/91 at the IEEE/EMBS Seattle Chapter Meeting, Seattle, WA.

Seminar on 2/18/92 at the HP Laboratories, Palo Alto, CA.

Seminar on 3/10/92 at UCLA, Los Angeles, CA.

Invited speaker on 3/11/92 at the National Computer Graphics Association (NCGA) Conference, Anaheim, CA.

Seminar on 3/20/92, Seoul National University, Seoul, Korea.

Seminar on 4/20/92 at Electrical Engineering EE500B, UW.

Seminar on 4/30/92, Eta Kappa Nu Lecture Series, UW.

Invited speaker on 5/5/92 at the Opening Ceremonies for the New Diagnostic Imaging Sciences Center (DISC), UW.

Seminar on "Multimedia Algorithms, Chips and Systems" during 9/30/92-10/2/92, Intel Corporation, Chandler, AZ.

Seminar on 10/9/92, GoldStar Central Research Lab, Seoul, Korea.

Invited Speaker and Session Chair on 10/14/92 at the Korean Federation of Sciences & Technology

Society's Fall Workshop on Medical Imaging, Seoul, Korea.

Keynote speaker on 11/3/92 for Cadence's Top-Down Design Seminar, Kirkland, WA.

Seminar on 11/9/92 at Electrical Engineering EE500B, UW.

Seminar on 11/10/92, Siemens Medical Systems, Issaquah, WA.

Seminar on 1/4/93 at Electrical Engineering EE500B, UW.

Seminar on 1/11/93 at Electrical Engineering EE500B, UW.

Invited speaker on 4/29/93 at the IEEE Oregon Section Meeting, Portland, OR.

Seminar on 7/8/93, Siemens Corporate Research, Princeton, NJ.

Visiting Professor from 11/22/93 - 11/26/93 at the University of Nantes, Nantes, France.

Seminar on 12/6/93 at Electrical Engineering EE500B, UW.

Seminar on 2/7/94 at Electrical Engineering EE500B, UW.

Seminar on 2/11/94 at Sony, San Diego, CA.

Presentation and demo of MediaStation 5000 on 2/13-2/14/94 at SPIE, Newport Beach, CA.

Seminar on 2/28/94 at Texas Instruments, Dallas, TX.

Seminar on 3/8/94 at Xerox Impact, Palo Alto, CA.

Invited speaker and demo of MediaStation 5000 on 3/9/94 at Texas Instruments News Conference, San Francisco, CA.

Held a Press Conference on 3/10/94 with presentation and demonstration of MediaStation 5000 at the University of Washington, Seattle, WA.

Invited speaker and demo of MediaStation 5000 on 3/16-3/23/94 at CeBit Conf., Hannover, Germany.

Demonstrated MediaStation 5000 on 3/16-3/17/94 at UW Computer Fair.

Seminar on 3/24/94 at Siemens Medical Systems, Erlangen, Germany.

Seminar on 3/29/94 at Microsoft, Redmond, WA.

Presentation and demo of MediaStation 5000 on 4/1/94 at Data Compression Conf., Snowbird, UT.

Seminar on 4/14/94 at Madigan Army Medical Center, Tacoma, WA.

Seminar on 4/18/94 at Electrical Engineering EE500B, UW.

Demonstrated MediaStation 5000 on 4/22-4/23/94 at Engineering Open House, UW.

Keynote speaker on 4/28/94 at the UW EE Industrial Affiliates Meeting, Seattle, WA.

Seminar on 5/17/94 at Panasonic, Yokohama, Japan.

Seminar on 5/17/94 at Sony, Tokyo, Japan.

Seminar on 5/18/94 at Kirin Techno-System, Yokohama, Japan.

Seminar on 6/07/94 at Veterans Administration, American Lake, WA.

Invited speaker on 6/07/94 at the Puget Sound Federal Health Council, Tacoma, WA.

Seminar on 7/05/94 at Veterans Administration Medical Center, Seattle, WA

Seminar on 7/06/94 at Madigan Army Medical Center, Tacoma, WA.

Invited speaker on 7/08/94 at the Argonne National Laboratory's Workshop, Argonne, IL.

Seminar on 7/10/94 at University of Wisconsin, Madison, WI.

Invited speaker on 7/15/94 at the UW Board of Regents meeting, Seattle, WA.

Seminar on 9/26/94 at Electrical Engineering EE500B, UW.

Presentation on 9/30/94 at General Electric Users Meeting, Seattle, WA.

Demonstrated MediaStation 5000 at DSP World, Electronic Imaging, Comdex, and RSNA in Oct. & Nov. 1994.

Invited speaker on 11/1/94 at SPIE Critical Review on "Defining the Global Information Infrastructure," Boston, MA.

Seminar on 12/5/94 at Electrical Engineering EE500B, UW.

Telemedicine presentation and demo on 01/13/95 at Madigan Army Medical Center, Tacoma, WA.

Seminar on 1/19/95 at Sony Electronics, Inc., San Diego, CA.

Seminar on 1/25/95 at Xerox Impact, Inc., Palo Alto, CA.

Seminar on 1/25/95 at Compression Labs Inc., San Jose, CA.

Seminar on 2/8/95 at Picker International, St. Davids, PA.

Seminar on 2/13/95 at Electrical Engineering EE500B, UW.

Seminar on 4/3/95 at Electrical Engineering EE500B, UW.

Seminar on 4/18/95 at the UW HKN meeting, UW.

Seminar on 4/19/95 at Siemens Medical Systems, Issaquah, WA.

Seminar on 4/24/95 at Electrical Engineering EE500B, UW.

Presentation on 4/27/95 at the UW EE Corporate Day, UW.

Invited speaker on 5/25/95 at the IEEE Computer Society and EMBS Seattle Chapter Meeting, Bellevue, WA.

Seminar on 6/5/95 at Hitachi Systems Development Laboratory, Yokohama, Japan.

Seminar on 6/6/95 at Hitachi Semiconductor Division, Tokyo, Japan.

Seminar on 7/3/95 at Hitachi Systems Development Laboratory, Yokohama, Japan.

Invited Speaker on 7/5/95 at the KISS-KOCSEA Workshop on Information Superhighway, Seoul, Korea.

Seminar on 7/6/95 at the LG Production Engineering Research Center, Pyungtaek, Korea.

Seminar on 7/8/95 at the Pohang University of Science and Technology, Pohang, Korea.

Visiting Professor from 7/10-7/11/95 at the Korea Advanced Institute of Science and Technology, Seoul, Korea.

Seminar on 7/10/95 at the Korea Advanced Institute of Science and Technology, Seoul, Korea.

Seminar on 7/11/95 at the Korea University, Seoul, Korea.

Invited speaker on 8/20/95 at the Fourth International Conference on Image Management and Communication (IMAC 95), Honolulu, HI.

Invited speaker on 9/2/95 at the KSEA International Technical Conference, San Francisco, CA.

Seminar on 10/2/95 at Electrical Engineering EE500B, UW.

Presentation on 10/26/95 at the UWEE Corporate & Professional Advisory Board meeting, UW.

Seminar on 11/16/95 at the George Washington University, Washington, DC.

Seminar on 11/29/95 at the University of Illinois, Urbana, IL.

Seminar on 1/12/96 at Sharp Laboratories of America, Camas, WA.

Seminar on 1/12/96 at Tektronix, Beaverton, OR.

Seminar on 2/6/96 at the Iowa State University, Ames, IA.

Seminar on 3/4/96 at Electrical Engineering EE500B, UW.

Seminar on 3/13/96 at HP Laboratories, Palo Alto, CA.

Presentation on 3/14/96 at DSPx Conference, San Jose, CA.

Presentation on 3/21/96 at Texas Instruments, Houston, TX.

Visiting Professor on medical imaging from 4/1l/96-4/12/96 at the Cleveland Clinic, Cleveland, OH.

Seminar on 4/11/96 at the Cleveland, Clinic, Cleveland, OH.

Seminar on 4/12/96 at the Cleveland Clinic, Cleveland, OH.

Seminar on 4/16/96 at the Purdue University, West Lafayette, IN.

Seminar on 4/22/96 at Electrical Engineering EE500B, UW.

Visiting Professor from 5/27-5/29/96 at the Korea Advanced Institute of Science and Technology, Taejon, Korea.

Seminar on 5/31/96 at the Korea Advanced Institute of Science and Technology, Seoul, Korea.

Seminar on 5/31/96 at the Korea Medical Insurance Corporation, Seoul, Korea.

Seminar on 6/7/96 at the Siemens Medical Systems Ultrasound Group, Issaquah, WA.

Seminar on 6/24/96 at the General Electric Medical Systems Europe, Paris, France.

Seminar on 9/4/96 at Analogic, Peabody, MA.

Seminar on 9/4/96 at Atlantic Aerospace Electronic Corp., Waltham, MA.

Seminar on 9/5/96 at Hewlett Packard, Andover, MA.

Seminar on 9/5/96 at Imaging Technology Inc., Bedford, MA.

Seminar on 9/6/96 at Mercury Computer Systems, Chelmsford, MA.

Seminar on 9/11/96 at Quadtek, Redmond, WA.

Seminar on 9/23/96 at Ewha Womans University, Seoul, Korea.

Seminar on 9/24/96 at Seoul National University, Seoul, Korea.

Presentation on 9/26/96 at Canon, Tokyo, Japan.

Seminar on 9/30/96 at Electrical Engineering EE500B, UW.

Seminar on 10/28/96 at Echotech, Munich, Germany.

Seminar on 10/28/96 at Siemens Medical Systems, Erlangen, Germany.

Seminar on 11/11/96 at Coreco, Montreal, Canada.

Held a joint Press Conference between the University of Washington and Siemens Medical Systems on 11/25/96 with presentation and demonstration of UWGSP8 at the University of Washington, Seattle, WA.

Seminar on 11/25/96 at Electrical Engineering EE500B, UW.

Demonstrated the UWGSP8 technology and commercial product at the Radiological Society of North America (RSNA) Conference from 12/1/96-12/6/96, Chicago, IL.

Invited Speaker on 12/4/96 at the IEEE EMBS Chicago Chapter Meeting, Chicago, IL.

Seminar on 12/5/96 at 3M, St. Paul, MN.

Seminar on 1/29/97 at ENSCO, Inc., Springfield, VA.

Demonstrated on 2/12/97 the UWGSP8 technology at the CEO breakfast meeting, UW.

Seminar on 2/12/97 at Bioengineering BIOENG 510, UW.

Demonstrated on 2/12/97 our technologies to the Washington State legislators, Olympia, WA.

Invited speaker on 3/6/97 at the Global Forum on Telemedicine, Vienna, VA.

Seminar on 3/25/97 at Hitachi Systems Development Laboratory, Kawasaki, Japan.

Seminar on 3/26/97 at Sony-Kihara Research Center, Tokyo, Japan.

Seminar on 3/27/97 at Samsung Electronics, Suwon, Korea.

Seminar on 3/28/97 at the Korea Advanced Institute of Science and Technology, Seoul, Korea.

Seminar on 5/13/97, IEEE & Eta Kappa Nu Lecture Series, UW.

Seminar on 5/19/97 at Electrical Engineering EE500B, UW.

Seminar on 5/26/97 at the University of Nijmegen, the Netherlands.

Seminar on 5/26/97 at the Department of Urology, University Hospital Nijmegen, the Netherlands.

Seminar on 5/28/97 at the University of Rennes, Rennes, France.

Seminar on 5/30/97 at the University of Nantes (IRESTE), Nantes, France.

Keynote speaker on 6/2/97 at the Canon Seattle Meeting, Seattle, WA.

Seminar on 6/26/97 at Washington State University, Pullman, WA.

Seminar on 6/27/97 at Key Technology, Walla Walla, WA.

Invited speaker on 7/26/97 in the UW Continuing Legal Education Course, "Pacific Rim High Technology Protection Practice Update," Seattle, WA.

Speaker on 8/15/97 at one of the focus groups during the Bioengineering Summer Symposium, Seattle, WA.

Invited speaker on 9/8/97 at the Information Technology Applications in Biomedicine Conference, Prague, Czech Republic.

Seminar on 9/25/97 at Tektronix, Beaverton, OR.

Seminar on 9/26/97 at Oregon State University, Corvallis, OR.

Speaker on 9/29/97 at one of the focus groups during the Inter-Regional Visit by St. Louis/Washington University, Seattle, WA.

Seminar on 9/29/97 at Electrical Engineering EE500B, UW.

Seminar on 10/7/97 at Samsung Electronics, Kiheung, Korea.

Seminar on 10/8/97 at LG Semicon, Seoul, Korea.

Invited speaker on 10/10/97 at the Fifth International Conference on Image Management and Communication (IMAC '97), Seoul, Korea.

Invited speaker on 10/28/97 at the 19th International IEEE/EMBS Conference, Chicago, IL.

Seminar on 10/31/97 at University of Michigan, Ann Arbor, MI.

Seminar on 11/6/97 at Bioengineering BIOENG 510, UW.

Seminar on 11/13/97 at Equator Technologies, Campbell, CA.

Seminar on 12/1/97 at University of Wisconsin, Madison, WI.

Presentation on 1/15/98 to the UW Board of Regents, UW.

Seminar on 2/9/98 at Electrical Engineering EE500B, UW.

Seminar on 2/11/98 at Bioengineering Faculty Lecture, UW.

Seminar on 2/16/98 at Sarnoff Corporation, Princeton, NJ.

Seminar on 2/20/98 at Sony Electronics, San Diego, CA.

Seminar on 3/17/98 at Matsushita Communications, Yokohama, Japan.

Seminar on 3/17/98 at Sony Corporation, Tokyo, Japan.

Seminar on 3/19/98 at ETRI (Electronics and Telecommunications Research Institute), Taejon, Korea.

Seminar on 3/19/98 at Adept Technology, San Jose, CA.

Seminar on 4/17/98 at Pennsylvania State University, State College, PA.

Seminar on 5/15/98 at Johns Hopkins University, Baltimore, MD.

Seminar on 6/1/98 at Electrical Engineering EE500B, UW.

Seminar on 6/12/98 at Mayo Clinic and Foundation, Rochester, MN.

Seminar on 6/16/98 at Canon Research France, Rennes, France.

Lecturer at the 1998 IEEE/EMBS Summer School, June 13-21, 1998, Berder Island, France.

Seminar on 6/22/98 at Canon Research Europe, Guildford, UK.

Seminar on 6/23/98 at Criterion Software, Guildford, UK.

Invited speaker at the Pacific Medical Technology Symposium-PACMEDTek, August 17-21, 1998, Honolulu, HI.

Keynote speaker at the UW Bioengineering Retreat, October 17, 1998, Friday Harbor, WA.

Seminar on 10/19/98 at Electrical Engineering EE500B, UW.

Seminar on 10/29/98 at Canon, Tokyo, Japan.

Seminar on 11/9/98 at Jeju National University, Jeju, Korea.

Seminar on 11/12/98 at Canon, Kawasaki, Japan.

Seminar on 11/16/98 at Myongji University, Yongin, Korea.

Seminar on 11/17/98 at Bioengineering BIOEN510, UW.

Demonstrated our technology, MAP1000, at the COMDEX '98, November 16–20, 1998, Las Vegas, Nevada.

Seminar on 12/7/98 at Electrical Engineering EE500B, UW.

Seminar on 1/4/99 at Electrical Engineering EE500B, UW.

Seminar on 1/15/99 at George Mason University, Fairfax, VA.

Seminar on 2/22/99 at Electrical Engineering EE500B, UW.

Grand round speaker on 3/15/99-3/16/99 at the University of Pennsylvania Medical Center, Philadelphia, PA.

Seminar on 4/21/99 at GAIO Technology Co. in Tokyo, Japan.

Seminar on 4/22/99 at Canon Central Research Center, Atsugi, Japan.

Seminar on 6/1/99 at Bioengineering BIOEN299, UW.

Seminar on 8/25/99 at Philips, Sunnyvale, CA.

Presentation on 8/30/99 at Canon Medical in Tokyo, Japan.

Keynote speaker on 9/1/99 in Tokyo, Japan, Mediaprocessor Forum organized by Hitachi.

Keynote speaker on 9/2/99 in Osaka, Japan, Mediaprocessor Forum organized by Hitachi.

Presentation on 9/6/99 at Matsushita Communications in Yokohama, Japan.

Seminar on 9/7/99 at Fujitsu Laboratories in Kawasaki, Japan.

Seminar on 9/27/99 at EE500B/BIOEN599K, UW.

Seminar on 10/5/99 at Bioengineering BIOEN510, UW.

Keynote presentation at the Bioengineering retreat on 10/9/99.

Seminar on 10/21/99 at ATL, Bothell WA.

Seminar on 11/4/99 at Bioengineering BIOEN510, UW.

Seminar on 1/6/00 at Bioengineering BIOEN599J, UW.

Seminar on 1/17/00 at Intel in Santa Clara, CA.

Seminar on 2/28/00 at the Department of Rehabilitation Medicine's Monthly Research Seminar Series, UW.

Keynote presentation on 4/24/00 at the MAP UWICL Consortium Meeting, Seattle, WA.

Seminar on 5/4/00 at Bioengineering BIOEN599J, UW.

Presentation on 5/16/00 at Hitachi Medical Corp., Kashiwa, Japan.

Keynote speaker on 5/17/00 in Tokyo, Japan, Mediaprocessor Forum organized by Hitachi.

Seminar on 5/18/00 at Hitachi Central Research Laboratory, Tokyo, Japan.

Seminar on 5/19/00 at Canon, Tokyo, Japan.

Invited speaker on medical imaging on 6/16/00 at Canon, Tokyo, Japan.

Keynote speaker at the Irish Signals and Systems Conference, 6/29-6/30/00, Dublin, Ireland.

Seminars on 7/10/00 and 7/11/00 at the University of Padova, Padova, Italy.

Seminar on 7/27/00 at LizardTech, Seattle, WA.

Lecture on 8/17/00 at the UW Executive MBA Program, UW.

Seminar on 8/21/00 at the Vanderbilt University, Nashville, TN.

Seminar on 8/30/00 at Sony, San Diego, CA.

Seminar on 8/31/00 at Texas Instruments, Houston, TX.

Seminar on 9/12/00 at Nanyang Technological University, Singapore.

Seminar on 9/14/00 at Sony, Tokyo, Japan.

Seminar on 9/25/00 at EE500B/BIOEN599K, UW.

Seminar on 9/26/00 at Bioengineering BIOEN510, UW.

Keynote presentation on 10/2/00 at the UW MPUC Consortium Meeting, Seattle, WA.

Presentation on 11/2/00 at the Washington Research Foundation Board meeting, Seattle, WA.

Seminar on 11/2/00 at Bioengineering BIOEN510, UW.

Keynote presentation on 11/20/00 at the MAP UWICL Consortium Meeting, Seattle, WA.

Seminar on 1/4/01 at Bioengineering BIOEN599J, UW.

Keynote presentation on 1/22/01 at the UW MPUC Consortium Meeting, Seattle, WA.

Seminar on 2/9/01 at Medtronic-Physio Control, Redmond, WA.

Seminar on 2/28/01 at VideoTele.com, Lake Oswego, OR.

Seminar on 2/28/01 at Tektronix, Beaverton, OR.

Presentation on 3/2/01 to the Washington State Congressional Delegation, Washington, DC.

Presentation on 3/14/01 to National Science and Technology Board, Singapore.

Seminar on 3/16/01 at Hitachi Medical Corp., Kashiwa, Japan.

Presentation on 4/6/01 at the UW Medical School Executive Committee, UW.

Keynote presentation on 5/14/01 at the MAP UWICL Consortium Meeting, Seattle, WA.

Keynote presentation on 5/14/01 at the UW MPUC Consortium Meeting, Seattle, WA.

Seminar on 5/24/01 at Bioengineering BIOEN599J, UW.

Presentation on 6/18/01 at Texas Instruments, Dallas, TX.

Keynote speaker on 6/27/01 at the 4th Embedded Systems Expo & Conference, Tokyo, Japan.

Presentation on 7/6/01 at National Science and Technology Board, Singapore.

Presentation on 7/16/01 at Hitachi Medical Corp., Kashiwa, Japan.

Seminar on 7/17/01 at Hitachi Systems Development Laboratory, Kawasaki, Japan.

Seminar on 7/19/01 at Samsung Electronics, Suwon, Korea.

Keynote speaker of a workshop on Bioengineering on 7/20/01 at KAIST, Taejon, Korea.

Presentation on 8/29/01 at TeraRecon, Inc., Concord, MA.

Seminar on 9/17/01 at Intel, Santa Clara, CA.

Seminar on 9/17/01 at Sony, San Jose, CA.

Seminar on 10/1/01 at BIOEN599K/EE500B, UW.

Seminar on 10/2/01 at BIOEN510, UW.

Seminar on 11/8/01 at BIOEN510, UW.

Seminar on 11/16/01 at EE592, UW.

Presentation on 12/13/01 at Matsushita, Tokyo, Japan.

Seminar on 1/10/02 at BIOEN599J, UW.

Invited speaker on 1/17/02 at the University of Texas, Austin.

Presentation on 2/13/02 at Micron Imaging, Pasadena, CA.

Presentation on 3/29/02 at Fujisawa Pharmaceutical, Tokyo, Japan.

Keynote presentation on 4/22/02 at the C64 Consortium Meeting, Seattle, WA.

Presentation on 5/16/02 at Fujisawa Pharmaceutical, Tsukuba, Japan.

Keynote presentation on 5/20/02 at the MAP UWICL Consortium Meeting, Seattle, WA.

Seminar on 5/22/02 at Bioengineering BIOEN480B, UW.

Invited speaker on 8/8/02 at the Texas Instruments Developer Conference, Houston, TX.

Presentation on 9/12/02 at Canon, Tokyo, Japan.

Presentation on 9/13/02 at Sony, Tokyo, Japan.

Invited speaker on 9/19/02 at the Georgetown University, Washington, DC.

Keynote presentation on 9/23/02 at the C64 UWICL Consortium Meeting, Seattle, WA.

Seminar on 9/30/02 at BIOEN599K/EE500B, UW.

Presentation on 10/2/02 at the Surgery Forum, UW.

Seminar on 10/14/02 at BIOEN599K/EE500B, UW.

Seminar on 10/29/02 at BIOEN299, UW.

Seminar on 11/14/02 at BIOEN510, UW.

Keynote speaker on 11/21/02 at the Embedded Technology 2002, Yokohama, Japan.

Seminar on 11/25/02 at Jeju National University, Jeju, Korea.

Seminar on 11/27/02 at Seoul National University, Seoul, Korea.

Invited speaker on 12/18/02 at the Conference on Gels, Genes, Grafts, and Giants: Transitioning into the 21st Century, Maui, HI.

Seminar on 1/9/03 at BIOEN599J, UW.

Invited speaker on 1/18/03 at the Forum on Innovation and Entrepreneurship in Biomedical Engineering Education, San Francisco, CA.

Demonstrated our JPEG 2000 encoder and decoder at NAB Exhibition, 4/7/03 – 4/10/03, Las Vegas, NV.

Seminar on 5/16/03 at School of Nursing, UW.

Seminar on 6/2/03 at Samsung Advanced Institute of Technology, Suwon, Korea.

Seminar on 6/4/03 at Seoul National University, Seoul, Korea.

Seminar on 6/5/03 at Pohang University of Science and Technology (POSTECH), Pohang, Korea.

Seminar on 8/19/03 at Singapore General Hospital, Singapore.

Keynote speaker on 8/22/03 at the Second International Symposium on BioSystems, Taejon, Korea.

Seminar on 8/25/03 at Samsung Electronics, Kiheung, Korea.

Seminar on 9/8/03 at the IBM Research Center, Yorktown Heights, NY.

Seminar on 9/29/03, 10/6/03, 10/13/03, 10/20/03, and 11/3/03 at BIOEN599K/EE500B, UW.

Seminar on 11/4/03 at BIOEN510, UW.

Lecturer at the 2003 College of Engineering Lecture Series, UW.

Seminar on 11/10/03 at Shanghai Jiao Tong University, Shanghai, China.

Seminar on 11/18/03 at BIOEN299, UW.

Keynote speaker on 11/12/03 at the Hitachi's ET2003 Private Conference, Yokohama, Japan.

Invited speaker on 11/29/03 at the NTU TIP Graduation Ceremony, Singapore.

Invited speaker on 12/15/03 at the National Science Council, Taipei, Taiwan.

Keynote speaker on 12/17/03 at the NSC-US Bioengineering Conference, Taipei, Taiwan.

Seminar on 1/8/04 at BIOEN599J, UW.

Seminar on 1/16/04 at Columbia University, New York, NY.

Presentation on 3/19/04 at the Everett Housing Authority, Everett, WA.

Speaker on 5/6/04 at the UW Dinner Series, Mercer Island, WA.

Lecture on 5/6/04 at BIOEN480, UW.

Presentation on 6/3/04 at Seoul Science High School, Seoul, Korea.

Lecturer in the International Summer School on Medical Devices and Biosensors, 6/26-6/30/04, Hong Kong.

Plenary speaker on 7/1/04 at the Symposium on Medical Devices and Biosensors, Hong Kong.

Keynote speaker on 7/21/04 at the Emerging Technologies Symposium, Seattle, WA.

Invited speaker on 8/19/04 at KAIST, Taejon, Korea.

Keynote speaker on 8/20/04 at the Third International Symposium on BioSystems, Taejon, Korea.

Distinguished speaker on 9/2/04 at the IEEE/EMBS Annual Conference, San Francisco, CA.

Keynote speaker at the International Bioengineering Conference 2004, 9/8-9/10/04, Singapore.

Invited speaker on 10/7/04 at the University of Illinois in Urbana Champaign.

Invited speaker on 10/9/04 at the University of Minnesota in Minneapolis.

Seminar on 10/12/04 at BIOEN299, UW.

Seminar on 10/18/04 at BIOEN599K, UW.

Seminar on 10/25/04 at BIOEN599K, UW.

Distinguished Lecturer on 11/4/04 at the University of California, Irvine.

Seminar on 11/9/04 at BIOEN510, UW.

Invited speaker on 11/10/04 at the Rochester Institute of Technology in Rochester, NY.

Keynote speaker on 12/28/04 at the 2nd Cairo International Biomedical Engineering Conference, Cairo, Egypt.

Many more presentations and demonstrations at the EE Department industrial reviews, Bioengineering, Radiology, Pathology Departments, professional conferences, workshops, tutorials, and formal and informal seminars at various companies, e.g., Boeing Aerospace Corp., IBM, Intel, Texas Instruments in Dallas and Houston, HP, Tektronix, Xerox, Micron, BBN, BBN Delta Graphics, MITRE, General Electric Medical Systems, Siemens Medical Systems, Siemens-Quantum, Picker, Sony, Hitachi, Toshiba, Canon, Sharp, Oki, Medtronic, Physio Control, CPI, Spectragraphics, Acucela, Equator Technologies, Seattle Silicon, Appian, Optimedx, Neopath, PDI, Asymetrix, Optimas, VLSI Technology, LSI Logic, Compression Labs, Brooktree, Ariel, Ithaca Software, Virtual Imaging, Indec, Aptec, ETRI, GoldStar, Samsung Electronics, Samsung Data Systems, Samsung Medical Center, Daewoo Telecom, Hyundai, Leading Edge Products, Zymos, Lotte-Canon, and others.

Continuing Education

Organized and taught the UW Engineering Continuing Education 24-Hour Short Course, "Image Processing," during 12/19/84 - 12/21/84 to 24 engineers.

Organized and taught the UW Engineering Continuing Education 30-Hour Short Course, "16 and 32-bit Microcomputer System Design," during 2/5/85 - 3/7/85 to 22 engineers.

Organized and taught the UW Engineering Continuing Education 42-Hour Short Course, "Digital Electronics and Computer Design," during 3/19/85 - 4/25/85 to 20 engineers.

Taught the UW Engineering Continuing Education 24-Hour Short Course, "Digital Image Processing," during 9/23/85 - 9/25/85 to 32 engineers.

Taught the UW Engineering Continuing Education 42-Hour Short Course, "Digital Electronics and Computer Design," during 1/21/86 - 2/27/86 to 15 engineers.

Taught the UW Engineering Continuing Education 30-Hour Short Course, "16 and 32-bit Microcomputer System Design," during 3/11/86 - 4/10/86 to 16 engineers.

Taught the UW Engineering Continuing Education 24-Hour Short Course, "Digital Image Processing," during 5/19/86 - 5/21/86 to 25 engineers.

Member of the organizing committee and taught a portion of "Modern Technical Concepts," to 15 technical managers during 9/21/86 - 9/26/86.

Taught the UW Engineering Continuing Education course, "Advanced Microcomputer System Design," during 4/14/87 - 5/14/87 to 31 engineers.

Taught the UW Engineering Continuing Education course, "Digital Image Processing and Computer Systems," during 9/23/87 - 9/25/87 to 20 engineers.

Organized and taught the UW Engineering Continuing Education Short Course, "Image Computing Systems and Applications: From Multimedia to Medicine," during 12/11/91 - 12/13/91 to 22 engineers.

Developed and taught the UW Engineering Continuing Education course, "Multimedia Algorithm, Chips and Systems" during 9/23/92 - 9/25/92 to 22 engineers.

Taught the Continuing Education course, "Multimedia, Algorithms, Chips and Systems" during 9/30/92 - 10/2/92 at Intel in Chandler, AZ, to 40 engineers.

Taught the UW Engineering Continuing Education course, "Multimedia Algorithms, Chips and Systems" during 12/9/92 - 12/11/92, San Jose, CA, to 15 engineers.

Taught the UW Engineering Continuing Education course, "Multimedia Algorithms, Chips and Systems" during 6/16/93- 6/18/93, to 14 engineers.

Taught the Continuing Education course, "Multimedia Algorithms, Chips, and Systems," during 11/22/93 - 11/25/93, Nantes, France, to 80 engineers.

Developed and taught a 1-week short course, "Media Processing, Processors, and Their Programming," during 5/25/98 - 5/29/98 in Seattle, WA.

Developed and taught (about 45%) a 4-week training course, "Mediaprocessors and Multimedia Processing" during 7/6/98 - 7/31/98 in Seattle, WA.

Developed and taught a 1-day short course, "Performance-Driven Programming on MAP1000" on 10/19/98 in Seattle, WA.

Developed and taught a 3-day short course, "Performance-Driven Programming on MAP1000" during 11/11/98 – 11/13/98 in Kawasaki, Japan.

Taught a 3-day short course, "Performance-Driven Programming on MAP1000" during 4/21/99 – 4/23/99 in Kawasaki, Japan.

Taught a 3-day short course, "Performance-Driven Programming on MAP1000" during 7/12/99 – 7/14/99 in Seattle, WA.

Taught a 3-day short course, "Performance-Driven Programming on MAP" during 5/17/00 - 5/19/00 in Tokyo, Japan.

Taught a 3-day short course, "Performance-Driven Programming on MAP" during 9/5/00 – 9/7/00 in Rochester, NY.

Developed a 5-week program with Nanyang Technological University, "Technopreneurship & Innovation Program" during 8/27/03 – 10/3/03 in Seattle, to 47 students from Singapore.

Offered a 5-week program with Nanyang Technological University, "Technopreneurship & Innovation Program" during 8/25/04 – 10/1/04 in Seattle, to 38 students from Singapore.

Others

Proposed and received equipment & software donation worth more than $3,000,000 from IBM, Texas Instruments, Hewlett Packard, Intel, Tektronix, VLSI Technology, Valid, Seattle Silicon, Cadence, Logic Automation, BIT, Fluke, Philips Medical, SUN Microsystems, Motorola, National Semiconductor, Samsung, NCR, Fairchild, Data I/O, TRW, Altera, Xilinx, Sony and other companies.

Invited and participated in the IBM Magnetic Storage Faculty Conference at IBM San Jose Research Laboratory, Feb. 20-21, 1985, HP Logic Symposium IX at Colorado Springs, June 12-14, 1985, IBM AEP Conference at San Diego, April 5-8, 1986, IBM AEP Conference at Boston, June 27- 30, 1987, and IBM AEP Conference at Berkeley, Nov. 13-15, 1987.

Member of the NIH Diagnostic Imaging Ad Hoc Study Section, 1993-1995.

Member of the research grant review team for the Whitaker Foundation in January 1995.

Member of the other NIH special study sections and the site visit team for research grant proposal reviews since Dec. 1984, and reviewed other NSF, NIH, National Sciences and Engineering Research Council of Canada (NSERC), and Hong Kong Research Grants Council proposals since 1984.

Member of the National Science Foundation (NSF) Faculty Awards for Women (FAW) Panel, and other NSF proposal review panels.

Member of the Medical Information and Image Management Consultation Committee for the Clinical Center of the National Institutes of Health (NIH), Oct. 24-25, 1988.

External expert reviewer of Ph.D. dissertations at other institutions.

Faculty Advisor for University of Washington Chapter of Tau Beta Pi, 1983 - 1985.

Coordinator of the campus-wide weekly seminar series on "Digital Image Processing Principles, Computer Systems and Applications," since 1984, and have invited more than 300 external and internal speakers on image computing, multimedia and medical imaging.

Selected in July 1990 as one of the outstanding young Koreans by *Chosun-Ilbo*, Seoul, Korea.

Selected in July 1990 by the *Seattle Weekly* as one of 39 people under 40 "who have made a difference and are likely to continue shaking things up in the 1990's".

Some of my research projects have been covered and discussed in detail at different times by various TV (CNN, national, local and foreign) & radio (National Public Radio and others) stations, wire services, and other publications such as the *Seattle Times,* the *Seattle PI, Business Week*, *EE Times*, and *Byte Magazine*, since 1986.

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The IEEE Standard Dictionary of Electrical and Electronics Terms

Sixth Edition

Standards Coordinating Committee 10, Terms and Definitions
Jane Radatz, Chair

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unwanted reflections of energy into the glide-slope sector. *See also:* navigation. (AE) [42], 686-1982s

MARshall System for Aerospace Simulation (MARSYAS) A simulation language used for simulating large physical systems, designed for use by people inexperienced in simulation or programming. Allows equations and FORTRAN subroutines to be written along with the statements describing a block diagram model. (C) 610.13-1993

MARSYAS *See:* MARshall System for Aerospace Simulation.

maser (1) (data transmission) (microwave amplification by stimulated emission of radiation) The general class of microwave amplifiers based on molecular interaction with electromagnetic radiation. The nonelectronic nature of the maser principle results in very low noise. (PE) 599-1985w

(2) (laser maser) A device for amplifying or generating radiation by induced transitions of electrons, atoms, molecules, or ions between two energy levels having a population inversion; microwave amplification by stimulated emission of radiation. (LEO) 586-1980w

mask (1) (A) (computers) A pattern of characters that is used to control the retention or elimination of portions of another pattern of characters. (B) (computers) A filter. (C) [20], [85]

(2) (software) A pattern of bits or characters designed to be logically combined with an unknown data item to retain or suppress portions of the data item; for example, the bit string "00000011" when logically ANDed with an eight-bit data item, gives a result that retains the last two bits of the data item and has zero in all the other bit positions. *See also:* interrupt mask. (C) 610.12-1990

mask document In word processing, a form displayed on a display screen with blank areas for the user to complete. (C) 610.2-1987

masking (1) (A) The process by which the threshold of audibility for one sound is raised by the presence of another (masking) sound. (B) The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound. The unit customarily used is the decibel. (Std100)

(2) (color television) A process to alter color rendition in which the appropriate color signals are used to modify each other. *Note:* The modification is usually accomplished by suitable cross coupling between primary color-signal channels. *See also:* television. (BT/SP) [32], [34]

masking audiogram A graphic presentation of the masking due to a stated noise. *Note:* This is plotted in decibels as a function of the frequency of the masked tone. (SP) [32]

masking, fault The result of applying error compensation systematically, even in the absence of error. (BA/C) 896.9-1994

mask&swap A data-access operation that stores a *next* value to the *test* specified bits within a specified data type and returns the previous data value. (C/MM) 1596.5-1993

maskSwap A bus transaction that stores bits of a *next* argument to a specified data address and returns the previous data value from that address. The affected bits are specified by a *test* argument. In the CSR Architecture this is called a mask_swap transaction. (C/MM) 1596.5-1993

masquerade The pretense by an entity to be a different entity. (C/LM) 802.10-1992

mass (International System of Units (SI)) The SI unit of mass is the kilogram. This unit, or one of the multiples formed by attaching an SI prefix to gram, is preferred for all applications. Among the base and derived units of SI, the unit of mass is the only one whose name, for historical reasons, contains a prefix. Names of decimal multiples and submultiples of the unit of mass are formed by attaching prefixes to the word gram. The megagram (Mg) is the appropriate unit for measuring large masses such as have been expressed in tons. However, the name ton has been given to several large mass units that are widely used in commerce and technology: the long ton of 2240 lb, the short ton of 2000 lb, and metric ton of 1000 kilograms (also called the tonne). None of these terms are SI. The term metric ton should be restricted to commercial usage, and no prefixes should be used with it. Use of the term tonne is deprecated. *See also:* units and letter symbols. (QUL) 268-1982s

Massachusetts General Hospital Utility Multi-Programming System (MUMPS) An ANSI standard programming system containing its own operating system, command language, and interactive programming language; designed specifically for medical applications and is particularly adaptable to string handling functions and management of hierarchical data. (C) 610.13-1993

mass-attraction vertical The normal to any surface of constant geopotential; it is the direction that would be indicated by a plumb bob if the earth were not rotating. *See also:* navigation. (AE) [42], 686-1982s

mass burning rate Mass loss per unit time by materials burning under specified conditions. (DEI) 1221-1993

mass loading The change in phase velocity of a surface acoustic wave produced by a thin layer on the substrate of higher density than that of the substrate; perturbations in reflections, velocity, and dispersion that occur due to loading effects of thin films on the substrate surface. (UFFC) 1037-1992

mass spectrograph An electronic device based on the action of a constant magnetic field on the paths of ions, used to separate ions of different masses. *See also:* electron device. (Std100) [84]

mass storage An area of storage, or a storage device, having a very large storage capacity. *Note:* Sometimes referred to as secondary storage in order to differentiate from main storage. *Synonym:* bulk storage. (C) 610.10-1994

mass unbalance (gyros) The characteristic of a gyro resulting from lack of coincidence of the center of supporting forces and the center of mass. It gives rise to torques caused by linear accelerations that lead to acceleration-sensitive drift rates. (AE) 528-1994

mast (power transmission and distribution) A column or narrow-base structure of wood, steel, or other material, supporting overhead conductors, usually by means of arms or brackets, span wires, or bridges. *Note:* Broad-base lattice steel supports are often known as towers; narrow-base steel supports are often known as masts. *See also:* pole; tower. (PE/T&D) [10]

mast arm *See:* bracket.

Master *See:* SBus Master.

master (1) (FASTBUS acquisition and control) A device that is capable of asserting or controlling an operation on a segment according to the FASTBUS protocol. A master may, in addition, contain slave logic. 960-1993

(2) (STD bus) A card controlling a bus transaction. The master that is currently controlling the bus is the current master. The card that is host to all other masters is the permanent master. All masters that are not the permanent master are temporary masters. (C/MM) 961-1987r

(3) (VMEbus) A functional module that initiates data transfer bus (DTB) cycles to transfer data between itself and a slave module. (BA/C) 1014-1987

(4) (VSB) A functional module that initiates bus cycles in order to transfer data between itself and VSB slaves. The master that is currently in control of the DTB is referred to as the *active* master. (C/MM) 1096-1988

(5) (NuBus) A bus device that initiates a transaction. (C/MM) 1196-1987

(6) (NuBus) A module that has acquired control of the bus through the control acquisition procedure. (BA/C) 1014.1-1994, 10857-1994, 896.3-1993, 896.4-1993

master antenna television system (MATV) A small television antenna distribution system usually restricted to one or two buildings. (C/LM) 802.7-1989

Universal Serial Bus Specification

Compaq

Intel

Microsoft

NEC

Revision 1.1
September 23, 1998

Chapter 6
Mechanical

This chapter provides the mechanical and electrical specifications for the cables, connectors, and cable assemblies used to interconnect USB devices. The specification includes the dimensions, materials, electrical, and reliability requirements. This chapter documents minimum requirements for the external USB interconnect. Substitute material may be used as long as it meets these minimums.

6.1 Architectural Overview

The USB physical topology consists of connecting the downstream hub port to the upstream port of another hub or to a device. The USB can operate at two speeds. Full-speed, 12 Mb/s, requires the use of a shielded cable with two power conductors and twisted pair signal conductors. Low-speed, 1.5 Mb/s, relaxes the cable requirement. Low-speed cable does not require shielding or twisted pair signal conductors.

The connectors are designed to be hot plugged. The USB Icon on the plugs provides tactile feedback making it easy to obtain proper orientation.

6.2 Keyed Connector Protocol

To minimize end user termination problems, USB uses a "keyed connector" protocol. The physical difference in the Series "A" and "B" connectors insure proper end user connectivity. The "A" connector is the principle means of connecting USB devices. All USB devices must have an "A" connector. The "B" connector allows device vendors to provide a standard detachable cable. This facilitates end user cable replacement. Figure 6-1 illustrates the keyed connector protocol.

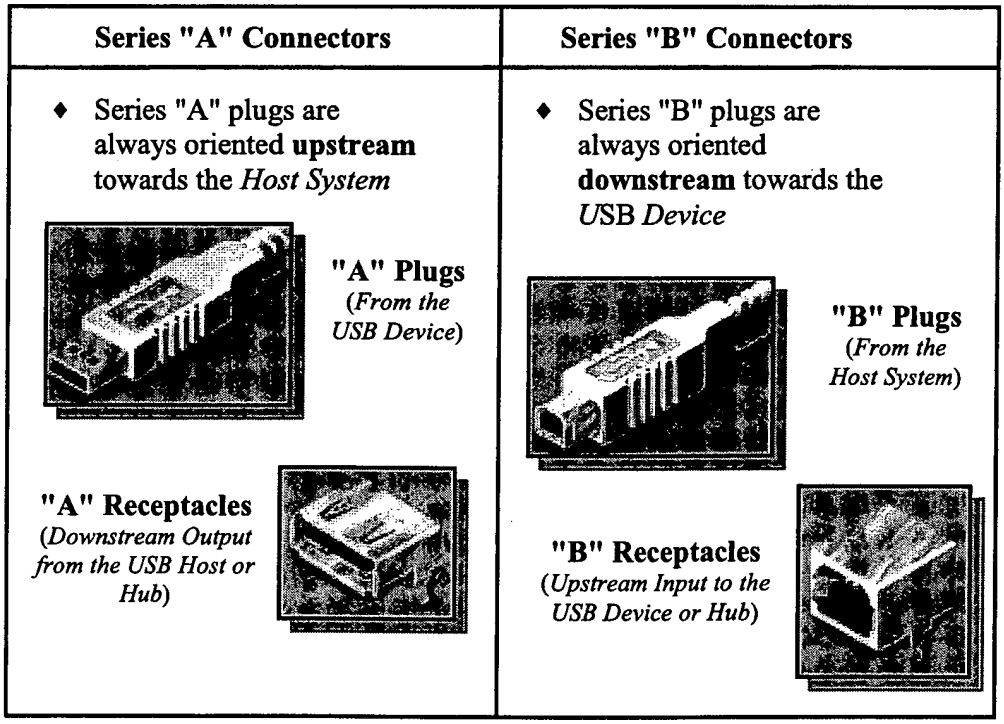

Figure 6-1. Keyed Connector Protocol

The following list explains how the plugs and receptacles can be mated:

- Series "A" receptacle mates with a Series "A" plug. Electrically, Series "A" receptacles function as outputs from host systems and/or hubs.
- Series "A" plug mates with a Series "A" receptacle. The Series "A" plug always is oriented towards the host system.
- Series "B" receptacle mates with a Series "B" plug (male). Electrically, Series "B" receptacles function as inputs to hubs or devices.
- Series "B" plug mates with a Series "B" receptacle. The Series "B" plug is always oriented towards the USB hub or device.

6.3 Cable

USB cable consists of four conductors, two power conductors and two signal conductors.

Full-speed cable consists of a signaling twisted pair, VBUS, GND, and an overall shield. Full-speed cable must be marked to indicate suitability for USB usage (see Section 6.6.2). Full-speed cable may be used with either Low-speed or Full-speed devices. When Full-speed cable is used with Low-speed devices, the cable must meet all Low-speed requirements.

Low-speed cable does not require twisted signaling conductors or the overall shield.

6.4 Cable Assembly

This specification describes three USB cable assemblies. Detachable cable, Full-speed captive cable, and Low-speed captive cable.

The color used for the cable assembly is vendor specific, recommended colors are White, Grey, or Black.

6.4.1 Detachable Cable Assemblies

Full-speed devices can utilize the "B" connector. This allows the device to have a detachable USB cable. This eliminates the need to build the device with a hardwired cable and minimizes end user problems if cable replacement is necessary.

Devices utilizing the "B" connector must be designed to work with worst case maximum length detachable cable. Detachable cable assemblies may be used only on Full-speed devices. Using a Full-speed detachable cable on a Low-speed device may exceed the maximum Low-speed cable length.

Figure 6-2 illustrates a detachable cable assembly.